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ABSTRACT

This action research project report described a program for enhancing thinking skills to improve the problem-solving and decision making of primary school students. Participating were 25 second and 22 third graders in regular education classrooms, but including students with special needs, located in two small middle class communities in central Illinois. The problem of insufficient problem-solving and decision-making skills was documented by means of teacher-made tests of thinking skills (patterns, math problems, reading vocabulary word recognition, reading comprehension) and surveys of teachers, administrators, and parents. The intervention consisted of: (1) language arts and mathematics materials designed to foster problem-solving and decision making such as deductive reasoning, analysis, and drawing conclusions, as well as activities including cooperative learning, social skills training, family homework activities, student journals of math problems, and cooperative activities with nursing home residents; (2) a re-design of the language arts and mathematics curricula to reflect skill infusion into the curriculum. The teachers' role was to guide thinking skills and decision-making through questioning and modeling. Teacher journals, charts, and a thinking skills posttest were used to document skill development. Post intervention data indicated an increase in student use of problem solving and decision making. Higher order thinking increased in the targeted mathematics and language arts skills. The majority of children improved in reasoning about time, estimates, patterns, mental math, and money. The children who were very successful often served as models for others. Parents responded positively toward the family homework. (Eight appendices contain data collection instruments and sample classroom materials. Contains 54 references.) (Author/KB)

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IMPROVING HIGHER ORDER THINKING SKILLS OF STUDENTS

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An Action Research Project Submitted to the Graduated Faculty of the School of Education in Partial Fulfillment of the Requirements for the Degree of Master of Arts in Teaching and Leadership

Saint Xavier University & IRI/Skylight
Field-Based Masters Program
Chicago, Illinois

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ABSTRACT

This report describes a plan for thinking skill development in order to improve problem-solving and decision-making processes. The targeted population consists of second and third grade students in two small middle class communities located in central Illinois. The problem of insufficient problem-solving and decision-making skills was documented through teacher-made assessment and observation checklists.

Underlying causes for the problem may be related to psychological pressures, family issues, and school district policies. The professional literature suggested causes connected to insufficient teacher training and an over emphasis on basic skills.

A review of solution strategies by knowledgeable others combined with an analysis of the problem setting resulted in interventions in language arts and mathematics: development of materials and activities that foster problem-solving and decision-making; and a redesign of mathematics and language arts curricula to reflect skill infusion into the curriculum.

Post intervention data indicated an increase in student use of problem-solving and decision-making. Higher order thinking increased in the targeted mathematics and language arts skills.

CHAPTER 1

PROBLEM STATEMENT AND CONTEXT

General Statement of the Problem

The targeted group includes second and third grade students in cooperative, inclusive self-contained classrooms. The students lack sufficient thinking skills needed for successful problem-solving and decision-making processes. Evidence for this problem includes test scores, teacher observations, and surveys.

Immediate Problem Context

This Action Research is taking place in two different elementary schools in two different communities. The two schools are located in small towns in a rural area.

School Site A

The targeted school is part of a unit district in a small Midwestern city. It is the sole public elementary school that serves the city as well as the largest preschool through grade four school in the county. It is part of a district that covers 113 square miles. The school was established in 1910. Four additions have expanded the original building to meet the current enrollment of 500 students. The school is considering another addition to meet increased population and technical needs of its students. This school is organized with self-contained classrooms.

The following information was obtained from the 1995 School Report Card. The average class size is 22 students. The racial ethnic background of the students is 99.2% White, .4% Black, and .4% Mexican-American. The pupil-teacher ratio is 21.9:1. The pupil-administrator ratio is 289.5:1. In addition, the per pupil

expenditure is $3,989. This rates significantly lower than the state average spent on a student. Low-income students number 17.5% of the total student body which makes them eligible to receive free or reduced price lunches. Student attendance is 96.4% while the student mobility rate is 11.8%.

The school's primary mission is to provide learning success for all students through a variety of programs. There is a gifted program with part time coordinators and an At Risk Program. There is daily instruction for students in physical education and music instruction for grades one through four. A Chapter I Reading Program is available to meet student needs. A Teacher Assistance Program is being implemented to assist students with problems in areas of health, behavior, academics, and attendance. A fully staffed library is available for all students and faculty. A wide range of educational classes are offered including programs for learning disabilities, physical therapy, speech, early childhood education, Headstart, and Bright Beginnings, a program servicing at risk preschoolers. Other educational opportunities are provided in dance, drama, and art through grade level programs held each year such as "We Love America", "Peter Rabbit", and "The Wizard of Oz". A Picture Person Art Program is also available for grades one through four and the fine arts are recognized during a week long celebration.

The targeted school employs over thirty people to provide quality instructional support to the students. Within the system, is a social interventionist and a veteran teaching staff that averages 13.9 years of experience, with 54.1% of the staff holding a master's degree. Staff development classes are offered to teachers for college credit on the campus. The building is administered by an in-house principal.

The curriculum has an objective-based approach. Each content area has level oriented objectives and uses primary and secondary resources to teach and reinforce objectives. The curriculum is continually being reviewed and revised to provide students with the most relevant instruction possible. Curricular decisions are

made by teachers and administrators with parental input. A Citizens Advisory Group meets regularly. Experienced teachers have developed local assessments. A criterion reference test is used to correlate curriculum to students' learning.

Fine arts is the current area of focus at this time. A fine arts committee has implemented a textbook for each teacher that provides ideas and art projects that enrich education in fine arts.

The State Board of Education has conducted an educational audit of the school. An evaluation of data has indicated that this school has met and exceeded the requirements.

Community A

The city was settled by a religious sect from Kentucky. They were interested in farming, religion, and education. A church was organized in 1832 followed by an academy in 1848. This academy later became a liberal arts college which is still part of the community today, and it is the alma mater of one of our United States presidents. This city is the county seat with the courthouse located in the city square. Across the street is a small modern community hospital providing medical services to the communities in the surrounding area.

The community is made up of 46% German heritage and is 94% Caucasian. The community has 4,306 inhabitants. It offers many newer subdivisions for those who wish to live or build a home in a more rural setting. The community is located midway between two large metropolitan areas. The nearby cities provide educational and cultural facilities, a publically funded junior college, several universities, large scale hospitals and a variety of retail services.

The median household income is $33,964. The two area nursing homes and local hospital are the main sources of employment. Many travel to the cities for other employment. Farming and farm related businesses are also major sources of employment. A variety of local, medical and retail services are available.

The city has a aldermanic form of government. City Hall has a staff consisting of the mayor, city clerk, treasurer and a full time city administrator. The police department has four full time police officers. It has twenty-five volunteer fire department persons trained in emergency rescue techniques. The grade school is part of a unit district of which there are two other grade schools in neighboring towns, a middle school, and a high school. The high school and middle school have an average of 500 students in each building and provide a quality education with competitive college prep courses. Approximately 80% of the district's graduates enroll in some form of higher education upon graduation.

The area churches reflect the attitudes and beliefs of many varied denominations. Some churches have existed as long as the town itself while others are new congregations. All share in the mission of caring for the spiritual needs of the community. An example of this is a house for the homeless that churches have sponsored and built together.

Communication between the school and community continue to be an issue of concern. Efforts to improve this are made by publishing school news and information in the local weekly newspaper and in a district newsletter. Efforts are also being made to invite the community to school functions and to utilize the expertise and talents of community members. Teachers are encouraged to take an active part in community affairs and be available for non-school functions.

Another school and community issue is curriculum. Dialogue continues over who is responsible for curriculum. The School Board has implemented a policy that includes input from both parents and teachers. Ultimately, the Board makes the final decision.

Wide community use of facilities includes many school functions in addition to youth sports activities, local scouts, a PTO carnival, adult recreation and local church usage. This fosters a school/community partnership.

School Site B

The targeted school is in a small town located in the Midwest. It is the sole public elementary school that serves the community. The district covers 75 square miles. It was established in 1952 for approximately 300 students. It has had five building additions to meet the current enrollment of 620 students and is considering another addition to meet the increased population and technical needs of its students. The school houses grades kindergarten through grade eight. Grades K-5 are self-contained and grades 6-8 are departmentalized.

The following information was obtained from the 1995 School Report Card. The average class size is 23 students. The racial ethnic background is 98.9% White, 0.5% Black, and 0.6% Mexican-American. The pupil-teacher ratio is 19.4:1. The pupil-administrator ratio is 311.5:1. In addition, the per pupil expenditure is $3,531.00. This rates significantly lower than the average spent on a student in an Illinois school. Low-income students number 16.2% of the total student body which qualifies them to receive free or reduced lunches or breakfasts. Student attendance rate is 96.5%, while the student mobility rate is 19.4%.

Emphasis is placed on students becoming independent and enthusiastic learners, and the school does its best to meet the needs of the students through a variety of programs. Kindergarten is a full day, every day program. A full time, certified Student Assistant Director coordinates the gifted, at risk, technological, and drug education programs. Daily instruction is held for all students in physical education. Instruction is given in art and music at all levels as well. Two Chapter I Programs are available to meet student needs. All students in grades one through eight receive the opportunity to choose German as a foreign language elective. A new computer lab with Internet access, a fully staffed library, and a certified art instructor are on staff for all students and faculty. Project THINK, Science Fair, and Algebra I for accelerated math and science instruction have also

been provided for the students. A wide range of educational classes are offered including programs for students with special needs, physical therapy, early childhood, and Bright Beginnings, a program servicing at-risk preschoolers. To meet the needs of working parents a before and after school Latch Key program is available.

In addition to the academic opportunities available at the school, a variety of extra curricular activities are available for the student population such as Scholastic Team, Cheerleading, Literary Club, Mathcounts, Science Club, Rocket Club, Photography Club, Grade 7&8 Chorus, Honors Chorus/Band, Grade 6 Chorus, Grade 5,6,7&8 Band, Marching Band, IGSMA Solo and Ensemble Contests, Flag Squad, Boys' Baseball, Cross Country, Basketball Track, Girls' Softball, Young Astronauts, Pom Pon Squad, and Student Council. The school also supports a, "Failure Is Not An Option Program."

The targeted school employs over 70 persons to provide quality instructional support to its students. Within the support system there is a social worker and psychologist who service the school. A student assistance team is available with teacher support for at-risk students in the areas of health, education, behavior, and attendance. The veteran teaching staff averages 16 years of experience with 39% holding a master's degree. The building is administered by both an in-house principal and superintendent. The superintendent holds a doctoral degree in education. He has encouraged the teachers to pursue more education and has received approval from the Board of Education to pay reimbursement for course work toward a master's degree.

The school offers a high quality educational program that maximizes the children's learning opportunities during the formative years. The primary emphasis and central focus of the targeted school and district is on quality elementary education. The school has been recognized by the United States Department of Education for "outstanding progress toward excellence in education." In addition, the school is a national winner in

Outstanding Compensatory Education Recognition Program sponsored by the office of the Secretary of Education.

The targeted school has been moving from self-contained mainstreamed classrooms and self-contained special education classrooms to more use of inclusion in the past several years. As a result teachers and aides of special education students are spending more and more time in the regular classrooms. Incorporating special needs students into the regular classroom has required much work and collaboration between regular teachers, special education teachers, and aides.

Community Site B

The community was planned and laid out on May 26, 1863, by William Davenport as an agent of the Hanover Company. It was incorporated as a village on April 26, 1875. The town was the county seat from 1843 to 1894. The only state landmark in this county is located on the square of this village. The courthouse is where Abraham Lincoln practiced when he rode the 8th Judicial Circuit to which this community was assigned from 1844 to 1856.

The community is primarily German heritage and is 99% Caucasian. The community has 2,517 inhabitants and also offers over 16 subdivisions in a more rural setting. The community is located in close proximity to a Midwestern city with easy access to opportunities and services of a metropolitan area. The nearby city provides larger educational and cultural facilities. A publically funded junior college, a private university, three large scale hospitals, a school of medicine, and a variety of retail services are available.

The median household income of the community is $36,400.00. There are a few small local industries, but most residents travel to a city close by for employment. Farms surround this community and several farm related businesses employ some adults from the community. A variety of small retail and medical services are offered to support this small community.

The village functions under the direction of six trustees and the village president. They meet twice a month, and are assisted by an attorney, engineer, clerk, and treasurer. The police department has three full-time officers and five part-time members. A 25 member volunteer fire department is trained in emergency rescue techniques.

The grade school is one of four feeder schools from outlying communities which feeds into one central high school that is located in the village. Each school is a district by itself. The high school is the largest with approximately 1000 students.

This is a religious church-supporting community. Worshipers can choose from five denominations. The Catholic Church has the most members. The Catholic Church also has a parochial grade school in this community with approximately 200 students.

One of the current school/community issues is the ongoing preparation for state school evaluation. Many inservices are being held on school improvement. Although the State Board of Education has changed some of their mandates about school visits, the grade school continues to work on improving and revising goals, objectives, and curriculum. These efforts are being monitored and reported in the local newspaper. Comparisons are often made among the various schools in the area of test scores and other school achievements.

The facility is used widely by the community; in addition to many school functions, there are many youth sports activities, local 4-H chapters, adult recreation, and senior citizen fitness programs. A community/school partnership is fostered.

National Context of the Problem

The problem of inadequate thinking skills is a critical issue facing educators across the nation. Many persons graduating from high school and college do not know how to reason, solve problems, or make decisions. Day's study (as cited in Worsham and Stockton, 1986, p.7) found that "Fewer than 40% of high school graduates are able to demonstrate higher-level thinking skills."

Another study by Makler (as cited in Worsham and Stockton, 1986, p.7) found that students are often unable to apply higher-level thinking skills and processes. This is not necessarily due to low intelligence. The problem is even more serious when the approach to instruction is pouring knowledge into students heads as if they were passive receptacles rather than active thinkers who are being taught strategies to find the answers. Goodlad's study (as cited in Worsham and Stockton, 1986, p.8) shows that the ratio of teacher talk to student talk is three to one. Only 1% of this teacher talk is requiring students to engage in anything beyond recall.

The National Assessment of Educational Progress (as cited in Worsham and Stockton, 1986, p.8) has found that many students are unable to solve word problems on standardized mathematics tests. Even though they can do the computation they lack the thinking strategies to change words into the appropriate mathematical process to solve the problem. Students are unable to transfer from abstract to concrete concepts.

An awareness of this problem has been here historically. More than 25 years ago the Educational Policies Commission (1961) stated (as cited in Worsham and Stockton, 1986, p.8) "The purpose which runs through and strengthens all other educational purposes-the common thread of education-is the development of the ability to think." In the 1980s educators began addressing the problem and giving attention on how to teach thinking strategies more effectively.

There is evidence that student behavior is directly related to thinking capability. Teachers have for years pointed out these relationships. Raths, who conducted a study, (as cited in Wasserman 1987, p.461 & 462) says "Certain behaviors of people reflect an incompleteness or inconsistency of thought. These behaviors reflect experience with thinking that has not been adequately rigorous." Raths gives eight patterns of inappropriate behavior which a teacher might use as evidence that a pupil's thinking might be impaired. First, students are very impulsive;

they act without thinking. Second, pupils are utterly dependent on help at every step of a task. Third, they are unable to formulate strategies to complete their goals. Fourth, students have difficulty comprehending and conceptualizing. They have difficulty seeing the larger picture. Fifth, students are sometimes unable to see alternative points of view. They often are convinced they are right and have the correct answers. Sixth, rigidity and inflexibility are also factors as students are afraid of change and resistant to new ideas. Seventh, pupils are underconfident and afraid of expressing their ideas and prefer not to answer when called upon in class. Last, some students are anti-intellectual and want simple answers that are "right" and prefer lessons rather than projects.

Evidence points out that students with poor thinking skills often function well in normal school experiences. Furthermore these thinking deficits are not identified or addressed. "In classrooms in which such lower-order exercises are stressed, pupils with thinking deficits will not only have little opportunity to practice and become adept at higher-order skills, but their deficits will also go virtually unnoticed. Teachers are likely to find about 9 or 10 pupils, in a normal elementary class of 30, who exhibit such patterns in the extreme." (Wasserman, 1987, p.462).

Research is continuing to point out that thinking is a prerequisite for good citizenship. Good thinking is important if people want to compete in the world for jobs and education. Ability to think also benefits a person's psychological well-being. The world community benefits, as well, from the person who is a thinker. The teaching of thinking skills is critical to all students' success in society. It has become apparent that the use of real world issues in teaching higher order thinking skills allows students to better internalize and link their prior knowledge with new knowledge. Transfer of learning is important also. The learner must play an active role in acquiring knowledge. According to Resnick (as cited by Fusco

and Fountain, 1987, p.6) "For real learning to occur students must be actively engaged in learning experiences that connect to their present knowledge and bridge to structures needed for future learning."

Researchers are continuing to study thinking skills and how to best make them part of the curriculum. Studies and theories continue to evolve on how to teach thinking skills. Cooperative learning is one practice that is being suggested and is being used to teach thinking skills. Most educators and researchers are stressing the importance of including instruction of thinking skills into the curriculum. Students need higher level thinking skills to master curriculum. Teaching these skills must be deliberate and continuous. If students are to learn how to learn they must be given time to think and time to talk about thinking. As teachers model and articulate active thinking skills, students move from passive to active learner(Rhoades & McCabe, 1992, p.43).

Theorists and researchers continue to look at similarities and differences between thinking skills and intellectual skills. The ties between the two are extremely close. Many current researchers believe that intelligence can be changed. "A major task of educators, then, is to introduce general skills, teach the subcomponents necessary for understanding, and provide practice opportunities to obtain mastery. Within this theoretical framework, the process of teaching thinking begins"(Rhoades and McCabe, 1992,p.44).

Another factor which is important to consider is the influx of technology. Knowledge is doubling every two or three years. It is becoming even more important to move from content to conceptualization. Facts or information, as they are known today may be obsolete tomorrow. Rapid accumulation of knowledge is known as the "information explosion"(Beyer, 1987 p.4).

The shift needs to be made to developing strategies and skills so children can learn how to learn.

> Teachers must be viewed as agents who assist students in becoming thinkers and involve students in the whole problem-solving enterprise. If students are to become thinkers teachers must emphasize higher order thinking, present strategies and skills in holistic or natural contexts, incorporate authentic real-world purposes, and goals into learning tasks, and integrate instruction across the curriculum.(Ebeling,Moore,Rieth, 1993, p.4).

CHAPTER 2

PROBLEM DOCUMENTATION

Problem Evidence

The targeted group includes second and third grade students in a regular education classroom that includes students with special needs. The students lack sufficient thinking skills needed for successful problem-solving and decision-making processes. Evidence for this problem includes test scores, teacher observations, and surveys.

Evidence for this problem will be shown by using the following measures: A thinking skills test will be administered to the students; a checklist, designed by the teachers, will assess thinking skills of students; an observation journal will be kept by each teacher during the school year as the study progresses. Interviews will be conducted with administrators on their views on thinking skills. A questionnaire to rate thinking skills being taught at the school will be given to each of the teachers.

Twenty-five third grade students and twenty-two second grade students were given a thinking skills pretest at the beginning of the school year. Questions dealt with patterns and problem-solving in math. Some questions also tested reading vocabulary, word recognition, and reading comprehension. The following bar graph (figure 1) compares scores on individual questions between grade levels. A copy of the test is included in Appendix A.

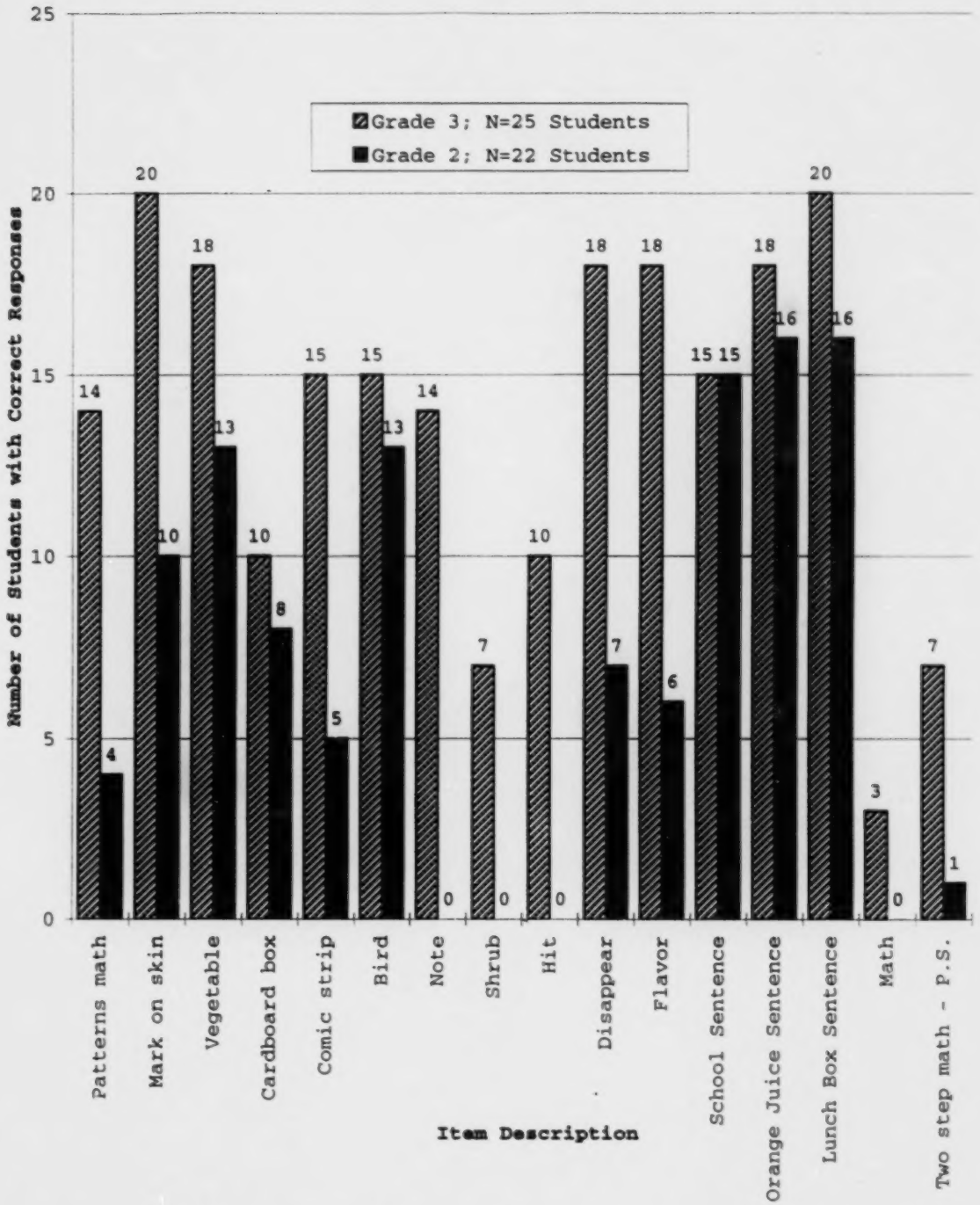

Figure 1. Pretest on thinking skills: Number of students with correct responses for each question.

Most children appear to be successful at analyzing a familiar sentence and applying a correct word to make it logical. Further analysis shows there is a marked difference between students in second and third grade in their ability to do patterns. Third grade students appear to be three times more accurate in responses to question one on patterns. This graph shows that 88 per cent of third and 100 per cent of second grade do not have a good understanding of mass and density as illustrated in question 15. Four percent of second and 28 percent of third appear to be successful in solving problems that involved two processes as shown in the last question. Questions one, fifteen and sixteen involved problem-solving skills in math. On vocabulary questions seven, eight, and nine there is a twenty percent difference in range. Scores were similar on question six between the grades. Other questions dealt with language skills. Scores indicate greater math problem-solving deficits than language arts deficits. All questions indicate a marked difference in higher order thinking skills between students in second and third grade.

Several conclusions may be drawn from the pretest. First, a deficiency may exist in problem-solving skills. Problem-solving involving two steps appears to be even more difficult for students in both grades. Teaching of problem-solving may need to be more frequent and systematic. Student understanding of mass and density appears to be very low. Students appear to do well at recognizing inappropriate words in familiar sentences. The reasons they are successful may be attributed to good background experiences both at home and at school. Students often appear to be unable to solve questions that deal with unfamiliar vocabulary words used in context. The difference in over all grade level scores in all areas may relate to maturity.

The following table outlines interviews with administrators regarding their opinions on four questions regarding higher order thinking skills. Questions are included in Appendix B. Responses ranged from three or more having the same opinions in column one to column three where individual responses were expressed.

Administrative Interviews

1. Degree that test scores indicate high levels of thinking.

Same	Alike	Different
--Kids not good test takers	--Extent depends on tests; tests not written for higher order thinking	--Lag between assessment research and practice
--IGAP does a better job indicating higher levels of thinking	--Science and social studies assessments do a better job	--ACT and SAT not a good reflection
	--One answer tests not a good assessment for higher order thinking	--Performance based assessment does a better job

2. Degree that higher order thinking is being addressed in schools.

Same	Alike	Different
--Hard for whole school to embrace higher order thinking programs		--Whole school needs to be in alignment
--Pockets of teachers are individually teaching higher order thinking		--Caring more about process, not always end result
		--Comfortable because high scores don't necessarily reflect high thinking skills
		--"If you always do what you've always done, you'll always get what you've always got."
		--Research hasn't caught up with tests
		--In favor of paradigm but still wants high scores
		--Higher order thinking skills not for low kids

3. How thinking skills can be addressed in curriculum.

Same	Alike	Different
--Build on curriculum integration each year	--Key is staff development (knowledge base, materials)	--Opportunity given HOTS in a non-threatening setting
--Integration into curriculum	--Community development (parent education)	--Need trust of faculty
	--Implementation includes all	--Teach how to analyze when you do staff development
	--Cooperative learning, problem solving, and group work are examples of it (strategies)	

4. Support staff needs to increase or improve higher order thinking.

Same	Alike	Different
--Teacher inservice (knowledge base)	--Experiment with structured activities	--Structure learning by doing in a non-threatening way
		--Support needs to come from administration and school district
		--Ongoing program that goes all the way up the line
		--May sacrifice higher test scores
		--Come up with new ways to assess
		--Don't throw out basic skills to teach thinking skills
		--Wants standardized assessment to catch up with research

Administrators agree on several things. First, students may not be good test takers. Second, IGAP seems to do a better job at assessing higher levels of thinking. Next, difficulty exists for whole schools to be instructing higher order thinking skills systematically in the schools. However, pockets of teaching higher order thinking skills do exist. Also teachers need to build on integrating thinking skills each year. Inservice training helps teachers with integration of thinking skills into content.

Two administrators agreed on several issues. One of the keys to more inclusion of higher order thinking skills in the schools is staff development. Parents and community also need to be involved in this process, as implementation of these skills takes everyone. The view was expressed that most standardized assessments are not written to test higher order thinking skills. So the concern was raised as to how to maintain high test scores, and infuse higher order thinking skills into the curriculum.

The most important conclusion was that there is a definite need for higher order thinking skills to be an integrated part of the curriculum. Although individual teachers are teaching higher order thinking skills, these schools do not have a systematic inclusive program currently in use. Many standardized assessments do not test higher order skills, so administrators do not want to risk lower test scores, which might happen as the shift is made to infusion of higher order thinking skills. Thoughtful schools do not come naturally. An awareness of what thinking is, is becoming essential.

A staff survey was conducted in two schools. In school A twenty-one teachers responded. In school B fifteen teachers responded. School A is a K-8 school whereas school B is a K-4 school. School A used a three point Likert scale ranging from low to high. School B used an agree/disagree scale. Questions were asked teachers about opinions of student higher order thinking skills. Included were questions on students' ability to do problem-solving, and to brainstorm. Questions included teachers'

opinions on students' ability to do patterns, comprehension, and to draw conclusions. Several questions inquired about ability of students to do reflection and transfer. The final question dealt with the need for a schoolwide thinking skills program. Copies of the survey are in Appendix B.

Table 1

Staff Survey of Higher Order Thinking Skills in School A and School B

Areas Surveyed	Low Site A	Average Site A	High Site A	Agree Site B	Disagree Site B
1. Students ability to solve problems	9	10	2	9	6
2. Students ability to brainstorm	8	8	5	13	2
3. Students identify a problem in a story	6	10	3	13	2
4.Draw conclusions after science experiments	4	10	3	13	2
5.Students use more than one strategy in math	8	6	3	10	5
6.Students draw conclusions verbal and written facts	7	10	4	10	5
7. Students transfer problem-solving to real life situations	4	4	13	9	6
8. Students identify patterns in numbers, objects, pictures, words	4	4	13	15	0
9. Students reflect verbally and in writing on thinking	13	5	2	8	4
10. Schoolwide thinking skills program needed	2	3	16	5	5

Some trends give a strong indication that students may not be able to solve problems. At school A, teachers report a noticeable problem in this area. Teachers in school B are equally divided on this issue. School B teachers have a strong agreement about students' ability to brainstorm. School A's scores are evenly divided. Teachers in both schools express the opinion that students are not using different strategies to solve problems. The teachers also express the same opinions on students inability to reflect about their thinking in writing.

Teacher response is varied about issues on the survey. Students appear to be able to identify patterns in numbers, words, objects and pictures. Generally, teachers agree on several issues. Students appear to be able to brainstorm. Students seem to be able to identify problems when they read a story. Also, students are generally able to draw conclusions on science experiments. About half of the teachers in both schools responded that students have difficulty transferring problem-solving to real life situations. Low and average scores indicate that students have difficulty reflecting verbally and in writing about their thinking. These scores may reflect the inability of students to use higher order thinking. School A appears to agree on students' inability to reflect and transfer thinking skills to real life situations. School B agrees 2 to 1 that their students can reflect. Does the ability to transfer and reflect change as students progress through the grades? Teachers continue to debate whether students can or cannot transfer problem-solving to real life situations. School A indicates a strong need for a schoolwide thinking skills program. School B is evenly divided on this issue. Again, do upper grade teachers see more deficiencies in thinking skills?

Surveys were distributed to fifteen second grade parents and 23 third grade parents. Parents were asked their opinion of higher order thinking skills. Table two compares opinions in the two grades. Copies of surveys are included in Appendix B.

Table 2

Parent Survey of Higher Order Thinking Skills

Area Surveyed	School B Agree	School B Disagree	School A Agree	School A Disagree
1.Television helps develop HOTS	1	14	6	15
2.Computers help develop HOTS	15	0	20	3
3.Teacher's task is to teach HOTS	15	0	21	2
4.Parents are involved in teaching thinking	15	0	22	1
5.Answer to a problem is more important than process	1	13	0	23
6.Daily conversation high priority in home	15	0	22	0
7.Reading high priority in home	16	0	21	2
8.Discussion about reading and television are important at home	14	2	22	1
9.Generally test scores very important	11	4	12	11
10.High test scores indicate high thinking skills	7	8	5	22

As the data indicate, parents agree on many areas. The parents agree that watching television does not contribute to higher order thinking. Parents feel using computers engage children in higher order thinking. Parents also feel that parents and teachers should share the responsibility for teaching higher order thinking skills. Parents agree answers are not as important as the explanation of the process. Daily conversation and

exchange of ideas are high priorities in homes. Reading is a daily part of home life and discussion about reading and television are important. The importance of test scores has some disagreement in school B. The scores are almost evenly divided in school A. The discussion about high test scores indicating higher level thinking runs almost even in school B. Over 80 percent disagree in school A that high test scores do not necessarily indicate higher level thinking skills.

Parents may be showing some confusion on several issues. First, parents appear to be in strong agreement that watching television does not promote higher level thinking but the use of computers does. The use of computers may not necessarily leave much time for conversation and exchange of ideas which parents indicate are high priorities in their homes. Parents appear to express agreement that the explanation of a process is more important than the answer, but also agree that high test scores indicate high thinking skills. Hand written comments by parents indicate discussion on issues in their homes is important.

Probable Causes

In analyzing the local site, probable causes may be inferred. Emphasis has been placed on high test scores. Most standardized tests do not test higher order thinking skills. So tests often set limits on what should be in the curriculum. More and more states and schools are moving to the use of performance based assessments that emphasize higher order skills. Parents feel it is the school's responsibility to teach thinking skills. Administrators are interested in keeping and maintaining their high test scores and struggle to make the paradigm shift. Teachers also struggle with how best to include higher order thinking skills in their already full curriculum. Teachers often know little about thinking skills instruction because it has not been part of their education and are unsure what part of the curriculum or content area to include when teaching thinking.

The literature suggests several causes for lack of thinking skills in the school setting. Curriculum and standardized assessment are not always in alignment. Students are being given basic skills to achieve high test scores but are not being instructed on how to think and how to problem solve. The National Assessment of Educational Progress (NAEP) is consistently reporting that students are unable to go beyond basic skills and have a real inability to elaborate, synthesize, and solve problems. "The pattern begins with the minimalism of basal readers say the curriculum reports, and continues through secondary texts and the minimum competency testing that emphasizes discrete, unelaborated skills." (Lewis, 1990, p.535). The school climate is not an environment conducive to thoughtful learning and encourages mere acquisition of knowledge and facts. Teachers struggle with how best to infuse higher level thinking skills into the curriculum. Parents sometimes hinder development of higher order thinking skills programs in the schools. Students themselves may make it difficult to implement thinking programs. They have often been taught and instructed to look for one right answer and memorize facts. Administrators also can act to limit teaching of thinking skills because administrators may be evaluated on their test scores (McGrane and Sternberg, 1992).

The vision of education in the past has been to provide every citizen with the basic skills necessary to live in our society. This vision has served us well but may not be enough or appropriate for the year 2000. McGrane and Sternberg(1992) state:

> Children today will need more than facts to succeed; they will need to know how to, and have the motivation to, continue learning throughout their lives. The occupations of the future will not require workers who can merely, add, subtract, read, and write. People will need to be able to think problems through, reason well, and come up with creative solutions.(p.335)

Higher order thinking skills have not been incorporated into our schools consciously and systematically. Beyer(1987) states

"Contrary to popular belief, skillful thinking does not just develop on its own."(p.2) It has been assumed that skillful thinking is natural and develops as students mature. Thoughtful schools and schools that stress thinking may not have been very evident. Slowly schools are realizing that it requires deliberate, continuing instruction and guidance and practice to develop thoughtfulness. Teachers have not realized how important it is to teach how to execute thinking tasks both in the school setting and outside the school.(Beyer,1987, p.2)

Possibly one of the major causes for a lack of thinking skills in the schools may be the teachers themselves. Teachers may not be thinkers themselves but may teach the same way they were taught. Teachers often skirt the real issue and want thinking to be as natural as walking and it rarely is. Teachers assume students learn how to think as they process information. Teachers feel they are to be the transmitters of knowledge and the student is to receive it, which is a passive form of instruction. Students are not given opportunities to practice approaches to thinking. Therefore problem-solving abilities may not be developed. Emphasis is often on the short answer and the right answer rather than the process. Focus may often be on isolated and basic skills. Then the learning does not build on what students may already know. "In order for teachers to be able to teach thinking, they need not only pedagogical skills--they need to be able to think themselves." (McGrane and Sternberg, 1992, p.338)

Curriculum has often been determined by standardized tests. Standardized tests have not tested thinking skills but rather have tested knowledge and facts. Teachers appear to be having difficulty moving from a basal reader approach to a more process oriented form of reading and writing instruction. The English Coalition Report *Democracy Through Language* in 1987 stated "The last thing American education needs is one more collection of inert information...to be poured raw into minds not actively engaged in reading, thinking, writing, and talking." (Lewis 1990

p.537) In mathematics, emphasis has been on computation and rules. The importance of problem solving is being realized. Efforts should be made to develop common sense about how to find an answer and how to choose a method or strategy. (Lewis 1990)

Administrators may be one more cause for limiting teaching of thinking skills. Teaching thinking skills effectively often takes years to yield results and administrators may want short-term results. Administrators may also establish curriculum which does not leave room for teaching thinking. Time may not be provided for staff development, support, and for implementation of whole school programs. "Teachers will more likely teach for thinking if they are in an intellectually stimulating environment themselves." (Costa, 1992, P.179). School administrators and teachers may not have worked together to model strategies and behaviors that thinking students need. Schools for the mind evolve as administrators, teachers, staff, and students work together.

Less time is being spent on questioning and conversation between student and adult. Thinking skills may not be developed as a result. The use of technology may have taken the place of adult conversation. Computers have little effect by themselves on the ability to learn. Less intelligent instruction may cause less skillful thinking. The most powerful and most under used technology in American society is sophisticated conversation between student and adult. Without adequate modeling of understanding through social interaction with adults, students will not develop intellectually. Conversation and questioning may determine whether technology will effect students' ability to construct meaning on their own(Pogrow, 1987, p.93).

The lack of teaching thinking skills may make it difficult to deal with the wealth of information being generated in the world today. Beyer(1987) states "Exclusive reliance on past information and knowledge derived from it, appears to be increasingly shaky as a basis for dealing with fast changing social, political, and economic worlds in which we live."(p.4)

In conclusion, the lack of higher order thinking skills may be caused by a combination of issues. These issues have worked together to obstruct the development of thinking in our society. Included in these issues are teachers, curriculum, technology, administrators, school climate, parents, assessment, basic skills model of instruction, and teacher training programs. As a result of these, society is calling for change to meet the demands of the future.

CHAPTER 3

THE SOLUTION STRATEGY

Literature Review

Addressing student's thinking is of vital importance in the schools. The need to develop better thinking among America's children has been well documented. The National Assessment of Educational Progress has data from both reading and math highlighting the problem as an overemphasis on skill instruction and multiple-answer testing. Growing concern is being expressed about critical thinking and reading skills of our nation's children (Ogle, 1992). "Reading IS a thinking process. Readers must regularly focus and set goals, make inferences, suspend judgments, make predictions, test ideas against text, and construct meanings for whole units of text" (Ogle, 1992, p.25). The literature presents a variety of suggestions for improving thinking. These can be categorized into the following areas: climates and attitudes that predispose thinking; skills involved; strategies to use in teaching thinking; the importance of, and tools for metacognitive reflection; and how to assess thinking.

Increasing pressure is being put on our schools and classrooms to teach thinking. The goal of education has been to provide children with all the facts and skills they need to succeed in our society. This has often been called the "assembly line model" or "basic skills model" (McGrane and Sternberg, 1992, p.334). This prevailing vision dominates every aspect of our education system including administrators, teachers, parents, textbooks, and curriculum guides.

The problem has become the implementation of this vision. It is becoming increasingly difficult to give children all the facts they will need to succeed in their world. Persons need problem solving skills, thinking skills, ability to reason well, and ways to come up with creative solutions to problems. Perkins (1992) has stated "We do not have a knowledge gap---We have a monumental use-of-knowledge gap"(p.4). .

The teaching of thinking has become increasingly important. Skillful thinking is not natural but needs instruction, guidance and practice to be fully developed. Student survival, both in and out of school is dependent on their thinking skill, and teachers have to know how to teach thinking tasks so students can be successful. Teaching thinking is important for what it can do for teachers and schools as more and more states are mandating testing in thinking skills. With the many changes in our world, it is becoming urgent to teach thinking in our schools. One dimension of this is the "information explosion." Information is being generated and continues increasing at a higher rate. This means individuals cannot acquire or master more than a tiny portion of it. Thinking skills, however, do remain constant in their usefulness in processing information (Beyer, 1987, p.4).

What is wanted or expected of education? Perkins(1992) has cited three general goals which are: retention of knowledge, understanding of knowledge, and active use of knowledge. Put together they are called "generative knowledge." These goals not only describe what the learner gets but also what the learner does with the knowledge and what the learner should be able to do afterwards.(p.6) This makes learning active.

The means for acquiring these goals are what Perkins calls "thoughtful learning." He states "Learning is a consequence of thinking" (1992, p.8). This premise suggests that knowledge comes with thinking and not as we have traditionally thought, after knowledge is acquired then comes thinking. So the call is being heard for thinking-centered schools rather than knowledge-centered schools (Perkins, 1992, p.8).

Momentum is building to make teaching thinking one of the major reforms in our schools. The call is coming throughout the nation from teachers, parents, The National Assessment of Educational Progress and the College Board to move thinking to the top of the educational agenda (Kirby and Kuykendall, 1991, p.8).

How to best achieve this goal is the question. Some focus on developing "habits" of the mind and some supporters focus on "processes" of the mind. Even though there is debate about how, there is agreement that students are not being taught to create or re-create for themselves a line of reasoning. They haven't learned to ask questions only to give answers (Kirby and Kuykendall, 1991, p.9). Students leave school to learn to think.

It is important to teach thinking for several reasons. Perkins (1992) cites educational problems as the principal reason. Student knowledge is quite fragile in several different ways. Some important knowledge is missing, some knowledge is inert, some knowledge is naive, and some is ritual or not really useful to anything outside of school tasks.(p.26) The fragile knowledge syndrome can be quite painful for lower-ability students as they may spend much of their schooling dealing with fragile knowledge unable to deal with confusion and gaps as more and more facts and materials are given to them. A consequence of this is poor thinking.(p.27)

Two other possible reasons to teach thinking are suggested by Perkins (1992). One is the trivial pursuit theory and another is the-ability-counts most theory. "Learning is a matter of accumulating a large repertoire of facts and routines."(p.31) Although many schools, educators, and teachers would not verbally acknowledge the trivial pursuit theory, it probably is alive and well in most classrooms and schools. Often little time is spent on discussions, students are poor problem solvers and have difficulty making inferences. The ability-counts-most theory says that "success in learning depends on ability much more than effort."(p.35) This theory often applies to math and parents often say their child does not have the ability to do math.

Teachers may unconsciously emphasize ability over effort. Yet, more and more the belief is that high IQ is not all that is needed for optimum learning to occur. "Schools don't treat all students as if they had minds and potential to learn. Students learn best where teacher expectations are high" (Kirby and Kuykendall, 1991, p.50). Often the problem is one of defective schools and not defective students. The myth of the monolithic IQ often hinders the learning process rather than helping. It may be time for intelligence to be measured in other ways (Kirby and Kuykendall, 1991, p.66).

Is it possible to create a culture of thinking? Schools need to foster a climate and positive attitudes toward the teaching of thinking. David Perkins(1993) again has some insights on thinking and bringing thinking into our schools. He says "To teach for thinking, it's not enough to teach skills and strategies. We need to create a culture that 'enculturates' students into thinking practices." (p.98) Enculturation involves three elements: exemplars, interactions, and explanations. In educational practice this means teachers provide exemplars by modeling themselves and bringing into instruction historical or fictional characters who show good thinking patterns. Teachers can be alert to student behaviors that provide exemplars and underscore them when they happen. In interactions, teachers can employ "wait time", use collaborative learning techniques, and provide assessments that require thoughtful analysis. In explanations, teachers can be opportunistic in explaining key ideas. They can label and explain important thinking moves when they are needed, and students can be questioned and pressed for explanations. Creating a culture for teaching thinking then becomes an ongoing enterprise (Perkins, 1993, pp.98-99).

In the midst of change and reform, Arthur Costa issues the challenge to develop supportive environments in our schools for thinking to occur. He proposes three environmental conditions that are necessary for optimum intellectual growth. One is that all participants share a common vision of the school as a home for

the mind. The vision must include faith in human intellectual potential. Schools must become thinking schools. Teachers keep journals, portfolios and share with colleagues new ideas and insights about teaching thinking. Philosophy, practices and policies reflect the vision set forth by the school. The vision begins to pervade all the school's communications. The whole school community including board members, students, teachers, administrators, classified personnel, and parents share a common vision for the school (Costa, 1992, p.175).

The second condition is that the process of thinking must become the content of curriculuum. Content must be selected to contribute to the thinking process. While students are expanding and growing in their intellectual abilities, teachers and administrators will also work to improve their own thinking as well. All persons in the thoughtful school continue to learn and expand the knowledge base (Costa, 1992, p.176).

The third condition needed for facilitating growth is the concept of the school as a community. Costa states "Together, individuals generate and discuss ideas, eliciting thinking that surpasses individual effort. Together and privately, they express different perspectives, agree and disagree, point out and resolve discrepancies, and weigh alternatives. Because humans grow by this process, collegiality is a crucial climate factor" (1992, p. 177). So an environment of trust, appreciation and recognition, sharing, caring, and celebrating are all part of thinking schools. The hypothesis then is "Teachers will more likely teach for thinking if they are in an intellectually stimulating environment themselves" (Costa, 1992 p.179).

Teachers, encourage students to push thinking, to take risks, and that it is okay to fail. Students need to learn to work for themselves and not just for the teacher or parents and to become self-motivated. The teacher should teach perseverance, and how to deal with frustration letting students know that sometimes it is a struggle to learn. Students also need to be aware of choices they have when they face obstacles, including running away from it,

going around it, or going through it. Students need to remember that discussion and debate are a part of learning. Criticism can be used constructively. Finally, students need to know they have self-worth no matter what their strengths and weaknesses (Kaplan, 1990, p.43).

The role of the teacher is many facetted in the thinking classroom. Many people think it is the teacher's role to help students be better thinkers. "Thinking teachers develop thinking students" (Kirby and KuyKendall, 1991, p.7). Teachers constantly try new strategies and new content. Questioning the why, how, what, when, and where of content is part of careful design by the teacher. Teachers are never satisfied. They constantly revise, change, and create new ways to teach (Perkins, 1993, pp.98-99).

Thinking skills cannot be taught haphazardly. So decisions need to be made and a plan made. To be most effective this plan should become districtwide. The plan should include a well thought out list of skills, a timetable and effective teaching strategies. A taxonomy is a list of specific teaching skills as well as a list of grade levels at which they should be taught or emphasized. Reis has divided this list into creative thinking skills, creative problem-solving and decision-making skills, learning-to-learn skills and metacognition. Specific skills listed under creative thinking skills include fluency, flexibility, originality, elaboration and guided imagery. Creative problem solving and future problem solving are included under problem-solving and decision-making skills. Critical and logical thinking skills include analogies, deductive reasoning, interpreting, inferring, patterns, classifying, and hypothesizing. Having a taxonomy helps ensure students will have a more organized and thorough approach to becoming good thinkers (Reis, 1990, pp.44-45).

Thoughtful schools and thinking teachers need to look at different ways of implementation before deciding on what is best for their particular school or classroom. First, teaching of thinking can be taught as separate course or stand-alone approach.

Second, teaching of thinking can be done strictly in content area by asking higher order questions. Instruction is solely on content, with no transfer, reflection, or use of thinking organizers. Infusion involves explicit attention to thinking but in the context of content area instruction. Graphic organizers are used in application, transfer, and reflection. Perkins and Swartz state "Infusion means direct and explicit attention to teaching thinking within content area instruction. Students' thinking benefits, and content learning proceeds with much more depth. Efforts to teach thinking should include infusion" (Perkins and Swartz, 1992, p.58).

Learning-to-learn skills are skills designed for younger students and provide a foundation to build higher order skills on. The learning-to-learn skills provide a framework for all the individual thinking skills that are taught and help students become more active learners. These skills should become a part of the daily curriculum. First, students connect what they learn to their daily lives. Next, they estimate how long it will take to do the lesson or project. Then, transfer is made to other learning situations. It is important to organize the task into essential parts and focus on a task step by step. Materials need to be identified and obtained before starting the project. Students should be given permission to collaborate with a friend or classmate. These skills can be added to and posted in the classroom. They can be used to introduce vocabulary and reinforce the thinking process (Kaplan, 1990, p.43).

As schools move into becoming thinking schools they have to decide whether they want to infuse thinking skills into the curriculum or develop a separate course on thinking skills. They also have to decide what kinds of skills they want students to learn such as critical or creative or those dealing with reasoning or problem solving. Programs such as Comprehensive School Mathematics Program (CSMP), Higher Order Thinking Skills (HOTS), Institute of Creative Education (ICE), Kids Interest Discovery Studies Kits (KIDS Kits), Sage for Gifted Students and Talents

Unlimited (TU) are programs designed to be infused into the curriculum though they are stand alone programs. Programs such as Cognitive Research Trust (CORT), Instrumental Enrichment (IE), Philosophy for Children and Structure of Intellect (SOI) are separate programs and are designed to be taught apart from curriculum (Baum, 1990, p. 53).

Although experts do not all agree on how best to teach thinking skills, most experts agree that some combination of separate and infused activities will get the job done best. Alvino believes "The first principle in creating a thinking classroom is to believe all students can think" (Alvino, 1990, p.41).

It is important then to decide what skills to teach and how to approach them. Students who are taught fewer thinking skills in greater depth learn them better. Research also has shown that students who were successful at using the skills were introduced to them at a simple level in the early grades then relearned through more complex operations in later grades (Reis, 1990, p.46).

The way to go about teaching thinking includes a variety of tools and strategies. Cognitive tools provide a practical medium for blending theory and practice (Swartz and Perkins, 1986 p.75). First, cooperative learning is an excellent way to enhance higher level learning. Think-pair-share combines wait time and collaboration. Students listen to a question, have time to think individually, talk with each other in pairs and then share responses with the larger group (McTighe and Lyman, 1992, p.75).

Collaborative learning methods have been successful in improving academic performance of students at various ages, grades and subjects. Cooperative learning facilitates the teaching of learning skills. Cooperative learning requires students to work together on assignments and tests and content when it is studied.

Students become the mediators, rather than just the teacher, as they explain to each other how they are thinking and their thinking processes. As they work in their groups they share with one another how they arrive at answers. Thinking occurs as

answers are shared verbally. This group thinking process helps develop thinking paths (Rhoades and McCabe, 1991, p.47).

Thinking paths are the way one thinks. They develop from birth on. They cluster and connect and grow. The vast majority of instruction in our schools does not give adequate time and opportunity for students to develop new thinking paths.

Cooperative learning is one way new paths can be learned. Students should be taught the concept of new thinking paths. Students need to know that good thinkers talk to themselves continuously. This is called self-talk or internal dialogue (Rhoades and McCabe, 1992, p.48). When persons share in groups how answers were arrived at, this gives others new paths of thinking and new ideas. Students are given alternatives to their thinking about events, problems, and situations. This becomes a mediation process. Students ultimately build up a thinking bank which they can draw from when faced with similar problems.

Within the cooperative learning framework are some other strategies which can enhance growth of thinking skills. The wrap-up is highly effective. The wrap-up is a follow up activity after a cooperative lesson. This can be structured to improve any area of thinking including analysis, synthesis, or recall. "Actively involving students with other students in the learning process is a best way to lead students to become more effective and efficient learners and problem solvers" (Schied, 1993, p.109).

Beyer has proposed a strategy of induction and a directive strategy as both being useful in introducing thinking skills. They can be used separately or together as each of these types is useful introducing new thinking skills and strategies (1987, p.88).

The inductive strategy allows students to find for themselves the thinking operation being introduced and then to master the skill with additional practice and guidance. First the teacher introduces the new thinking operation in the context of the subject being studied. Next the students complete a short assigned task executing the skill. Then students reflect and

share what they did. Another task is given and students try to use what they have discovered about the skill and apply it to new data. Finally students conclude by reporting again on what they believe they did in their minds to execute the new strategy. By conducting lessons using these five steps teachers take what students already know and add to that knowledge by carrying on guided practice (Beyer 1987, p.89).

In some thinking strategies the teacher has to be more direct as the thinking skill is more complex, or students are just beginning a new operation, or are truly beginners. This is when Beyer(1987) recommends using what he calls a directive strategy. First, the operation is introduced by the teacher. Next, the teacher explains in detail the key steps in sequence. Then, the teacher shows the students in step-by-step fashion how to carry out the operations and the procedures used in sequence. Discussion of the demonstration is done at this point reviewing the attributes of the operation. Then, the students apply the skill as it has been modeled either individually or in groups. Finally, the students reflect on how they executed the operation. Particular attention is paid to processes used and any difficulties they had(p.100). Reis states "Clearly, with the current explosion of knowledge and the overwhelming amount of content required in most subject areas, teaching how to think, rather than what to think, is a necessary goal in all classrooms" (1990, p.48).

In order to teach thinking, the role of the teacher must also change. First and foremost, the teacher must be a cognitive guide. Higher order thinking is at the center of knowledge acquisition. Cognitive guided instruction provides students with opportunities to see how the concepts apply in a variety of situations (Schied, 1993,p.3). Instead of the teacher being a dispenser of information, the teacher acts as a guide to help children think through problems and build on information that they already possess. The student becomes an active learner. Beyer,(as cited in Walberg,1991) states "Processing information

rather than receiving and repeating it is important" (Keefe & Walberg 1991, p.95).

Teachers coach students how to think rather than telling them what to think. Questions are favored by the teacher over answers. Listening to student response is the bottom line. Teachers must become careful reflective listeners. They must also believe in the minds of the their students. Teachers must believe in the potential of their students (Kirby and Kuykendall, 1991, p.50). Teachers must become more powerful thinkers themselves.

The teacher must also act as a model to promote successful thinking. As a model, the teacher tinkers with new strategies and new content. Thinking teachers model behaviors that support thought processes; this becomes very important when teaching strategies (Rosenshine & Guenther 1992, p.40). Perkins strongly recommends modeling for teaching success in thinking. He states that modeling not only involves demonstration, it involves explanation and execution. Explaining options is also vital to success in teaching thinking. In order to make themselves models teachers must pause to reflect, think aloud and explore options (Perkins 1993 pp.98-99). "Thoughtful teaching means sharing that crumb of power with students, and requires surrendering a substantial portion of the last vestiges of instructorship. It means finding ways to put the knowledge makers in charge of knowledge making" (Kirby and Kuykendall 1991 p.62). This presents a challenge to the education system we are a part of.

Other strategies become cognitive tools needed to solve problems. "The more strategies you have, the more confident you become, the more willing you are to tackle new problems, and the better problem solver you become" (Sternmark, Thompson, and Cossey, 1986 p.xii). Teachers and students can present and model strategies. These strategies can be depicted on charts such as the problem-solving strategies wheel or the reading wheel (McTighe and Lyman, 1992, p.85).

Graphic organizers are valuable tools to provide a visual, holistic representation of facts and concepts and their

relationships (McTighe and Lyman, 1992, p.81). Teachers and students use them in many ways from kindergarten through college. They are a way to represent abstract information in a more concrete form. They can show relationships between facts and concepts. They can give ideas for writing. They can help relate new information to old knowledge. Graphic organizers can store and retrieve information and can be used in student assessment. Some more widely used graphic organizers are PMIs, Venn diagrams, webs, sequence charts, character maps, concentric wheels, and story maps (McTighe and Lyman, 1992, p.81).

Clustering is another technique where both teacher and student can look into almost any topic and use the resources of the brain. This is a way to give opportunity to discuss a students way of thinking and how everyone's ideas are different. Constructing a map of a story or event or a concept is another way of organizing information as it is collected (Tiedt, Carlson, Howard, and Watanabe, 1989, pp.21-23).

Teachers continue to wrestle with how to teach higher-level thinking operations. One procedure that successful teachers use is called scaffolds. Rosenshine and Meister state "Scaffolds are forms of support provided by the teacher (or another student) to help students bridge the gap between their current abilities and the intended goal" (1992, p.26). Scaffolds can be used for many skills but are particularly useful for higher-level cognitive strategies. Instead of providing explicit steps, one supports or scaffolds the students as they learn the skill. So when using scaffolds it is important to determine if students have adequate background ability.

Teachers present the new cognitive strategies by using a concrete prompt, modeling the skill, and thinking aloud. Thinking aloud is particularly useful in teaching problem solving in math. "Thinking aloud by the teacher and more capable students provided novice learners with a way to observe 'expert thinking' usually hidden from the student" (Rosenshine and Meister, 1992, p.28). Difficulty is regulated during guided practice by starting with

simple tasks and moving to more complex tasks, or completing part of the task for the student, or providing cue cards, or presenting materials in small steps and anticipating student errors and difficult areas. The next step is to provide varying contexts for student practice. Feedback should be provided through teacher led discussions, checklists and models of expert work. Student responsibility is increased by diminishing prompts and models, increasing complexity of tasks, practicing putting all the steps together, and checking for student mastery. Independent practice then allows the blending of the elements of the strategy into a single, unified whole. "This suggests a continuum from well-structured skills to cognitive strategies" (Rosenshine and Meister, 1992, p.32).

Cognitive activities that bridge the gap between home and school are excellent sources of transfer. Family math is an excellent source of transfer. These activities help the family explore problem solving situations in the home. Many math series have family math problems that go along with the text as well. Family Math by Stenmark, Thompson, and Cossey(1986) is an excellent source for problem solving materials. Family math can be incorporated into a school calendar that can be sent home once a month. A weekly family math situation can be presented. Family activities for reading can be incorporated into this calendar. Ideas for these can be found in basal reading series. Parents and children learn together to develop problem-solving skills to build understandings. Parents become accountable along with students, Together they share ownership in thinking and learning.

Metacognition or thinking about thinking is an important component for effective thinking. Teachers can be alert to metacognition and this can be taught and modeled in the classroom. Teachers can verbally label their responses while solving a problem. Teachers can model metacognition by sharing their own thought process with the students. Teachers can encourage students to metacogitate or share their thinking verbally about concrete objects. Internal dialogue is what they said to

themselves when confronted with a specific problem, question, or situation (Rhoades and McCabe, 1992, p.47).

Costa suggests "metacognition is having the ability to know what we know and what we don't know and wondering why we are doing what we are doing" (Costa, Bellanca and Fogarty, 1992, p.10). Metacognitive processing involves planning, monitoring and evaluating learning activities. Students become aware of their own thinking and what goes on inside their heads prior to during, and after a learning activity. Metacognition includes different levels. They include: tactic use, or doing a kind of thinking without thinking about it, aware use, where one is conscious of doing a certain kind of thinking, strategic use, or organized thinking by a conscious strategy and reflective use, or reflecting upon thinking before, during, and after the process (1992).

> Thinking about your own thinking, or, metacognition, depends on abstract reasoning that develops more fully as children mature. But that doesn't mean elementary teachers should ignore metacognition. You can instill positive attitudes toward learning by teaching 'learning-to-learn' skills that prepare younger students to plan, monitor, and assess their own thinking about learning as they become developmentally ready. (Kaplan 1990, p.42).

Reflective thinking can be done in several ways. "Mrs. Potter's" questions are standard metacognitive questions that reflect thinking and can be posted in the classroom for referral. Another tool useful in metacognition is de Bono's PMI. Students can readily assess their own behavior. Costa states "Regardless of the means or measures used for the metacognitive process, the evidence is clear that explicit attention to the metacognitive--the stuff beyond the cognitive answers--promotes transfer and application of knowledge, skills, concepts and positive attitudes in novel situations" (Costa, Bellanca and Fogarty, 1992, p.12).

Student journals and learning logs are valuable tools to help process thinking. Students record personal responses, queries,

feelings, changing ideas, thoughts, and knowledge about processes and content of their learning (Wilson and Wing Jam, 1993, p.85). Students are involved identifying, analyzing, and reflecting on aspects of their learning. When students are able to put their experience in their own words learning becomes more meaningful and personal. Through reflection students learn more about themselves and develop analytical, reflective and metacognitive skills (Wilson and Wing Jam, 1993, p.86).

"All teaching is for transfer; all learning is for transfer. To extend learning; to bridge the old and the new; and to lead students toward relevant transfer and use across academic content and into life situations, is the mission of the thinking classroom" (Fogarty and Bellanca, 1993, p.39). Sometimes learning for transfer is clear and explicit. However in some instances, transfer seems far removed from across the content and into real life. Most transfer is complex rather than simple. So bridging strategies are used to help make application, or to transfer. Six transfer strategies which Fogarty and Bellanca illustrate can be used by teacher and student alike. They include overlooking opportunities, duplicating, replicating, integrating, mapping, and innovating(1993). These six dispositions of transfer do not necessarily occur in sequence but do seem to move from simple to more complex. Once teachers and learners become aware of these levels of transfer, more attention is given to transfer as learning continues (Fogarty, 1992, p.353).

Teachers can evaluate thinking in the classroom in responsible ways. "Analyzing the artifacts of thought in the classroom may never be an exact science" (Kirby and Kuykendall, 1991, p.193). Consideration of these guidelines can be helpful. First, openness and authenticity need to be considered. A great deal can be learned by examining how students generate ideas, pose questions, select alternatives, solve problems, work through preliminary drafts, seek and respond to criticism, stay on task and reflect on their work (Kirby and Kuykendall, 1991, p.193).

Costa, (as cited in Beyer 1987) has suggested a list of behaviors that are indicative of an effective thinking student. These could be the standards teachers use to assess thinking activities. First, the student is persistent in applying the task until it is achieved. Second, he plans how to execute a thinking task. Third, he is flexible in his approach from a number of angles. Next, he can tell you the steps he engaged in or his strategies. Data that is missing is identified and located. Test papers are checked for accuracy, completeness and clarity. Questions are posed about causes and relationships. Evidence of assertions are given and requested. Past experience and previous knowledge are drawn on and transferred to other contexts. Use of precise language is valued. Expression of enjoyment of thinking exhibits pride in the result that is gotten.

One way to evaluate thinking is to keep anecdotal notes in teacher journals. "Intelligent behavior shows up when a child knows what to do when he does not know--when he figures out where to get an answer when he doesn't have it" (Kirby and Kuykendall, 1991, p.187). By recording specific incidents of student behaviors, indicative of skillful thinking, teachers are likely to see a thorough and a realistic appraisal of the thinking proficiencies of their students (Beyer 1987, p.239).

Another way to assess student thinking is by paper and pencil tests. There are guidelines that suggest authentic assessment. First questions are open-ended. Second, they are not solvable by routine methods. Understanding is required to solve them. Time is also needed. The pulling together of subject matter is expected. Writing of explanations is involved. The products of the test may be in the form of an essay, lesson plan or a problem set for others to solve. Authentic assessment can be a learning as well as a testing experience (Perkins, 1992, p.176). The tests of tomorrow will focus less on the answer itself and more on the method the student uses to arrive at it.

A third way to assess thinking is by designing projects and activities that assess progress. These activities suggest that

students are diligent, thoughtful, engaged, persistent, thorough, in what they learn (Beyer 1987, p.239).

Students can be involved in the assessment process. When they are involved they become more analytic and reflective about their learning and they value their role in controlling it which puts them in a better position for improvement (Wilson and Wing Jam, 1993). One way to do this is to allow students to choose assessment processes. Questioning students about what they learned and listening to responses is an assessment tool. "Mrs. Potter's" questions are good to use as a means of reflection (Bellanca and Fogarty 1991,p.266). Another form of assessment is by use of profiles or portfolios. Choosing what to put in makes the student an active participant. Discussions which involve questioning and reasoning about these are good. Listing skills that you expect and asking them to contribute toward this list is proactive. Having students rate themselves and others makes them more aware of what is expected of them (Wilson and Wing Jam, 1993).

So the vision is changing. The goal for educators is to become more than dispensers of knowledge. It is no longer enough to give just facts and knowledge. We must guide students in ways to become active learners. The new vision calls us to become "reflective practioners." We must be willing to learn, grow and change. Reflective practioners are always questioning their goals and aims. By monitoring and reflecting on short and long term plans, we can determine what is best for students (Ackerman, 1993, p.351). The new vision calls for thoughtful schools or homes for the mind where all who are a part of the education process become thoughtful and reflective persons.

Project Objective and Processes

As a result of cognitive guided instruction, during the period of September 1996 to February 1997 the second and third grade students from the targeted classes will increase their ability to use problem-solving skills and decision-making processes in mathematics and language arts as measured by teacher constructed assessments and review of student self assessments.

In order to accomplish the project objective the following processes are necessary:

1. Materials that foster problem-solving and decision-making in language arts and mathematics will be developed.
2. Activities that address problem-solving and decision-making processes will be developed for both mathematics and language arts.
3. Mathematics and language arts will be redesigned to reflect the infusion of problem-solving and decision-making skills into the curriculum

Project Action Plan

As a result of cognitive guided instruction, during the period of September 1996 to February 1997 the second and third grade students from the targeted classes will increase their ability to use problem-solving skills and decision-making processes in mathematics and language arts as measured by teacher constructed assessments and review of student self assessments.

The following action plan was designed to accomplish three major processes; developing activities that address problem-solving and decision-making processes, and redesigning mathematics and language arts activities that reflect the infusion of problem-solving and decision-making into the curriculum.

Materials that will be used to implement the first component in language arts are the reading textbooks (Harcourt Brace, 1995), trade books, and resource books that include critical and creative

thinking activities. Also included are extensive use of graphic organizers and teacher-generated materials.

Materials used to teach problem-solving and decision-making in math will be the textbook, (Addison Wesley, 1987 and 1993), and resource books. Graphic organizers will be used along with manipulatives. Daily problem solving will be implemented through the use of logs and real life situations.

Four activities have been designed to incorporate problem-solving and decision-making skills. Cooperative learning will be used as one. Some activities will be done in groups of three to five. Some activities will be done in partners. Social skills, including listening, trust-building and communication, will be worked on along with problem-solving and decision-making. (see Appendix C). Strategies will be shared in groups and with other groups on how to solve problems. These groups will meet two to three times a week.

Problem-solving and decision-making will be implemented in language arts. Reading/thinking journals will be used along with the practice book to record skills. Graphic organizers, including PMI, Venn diagrams, KWL, and prediction charts will be used (see Appendix D and E). Assessment will include teacher journals, and students' reading/thinking journals and checklists.

Wordsplash is a good way to begin the year to introduce one's self. They can also be used before, during, and after a unit.(see Appendix F). Wordsplashes are collages of words and pictures that help students think and make connections. (Cummings, 1990, p.69).

Problem-solving and decision-making will be implemented in mathematics as well. Cooperative learning will be used making use of base groups, task groups, and partners. Whole group instruction also may be used. Methods will include math logs, cooperative learning, graphic organizers, textbooks, and homework tasks.(see Appendix D). Daily assessment will include math logs, teacher journals, and checklists in one form or another.

A homework activity will be given weekly which includes problem-solving and decision-making. These may include a family

math activity from Family Math by Stenmark, Thompson, and Cossey. This is an excellent source for problem solving materials. Family math can be incorporated into a school calendar that is sent home once a month or a weekly assignment sheet. (see Appendix D and E). Assessment will be done through a checklist kept of returned activities and parent documentation. (see Appendix G).

The targeted classes will visit and take part in activities with area nursing home residents. Cooperative activities and interviews will include reading, math problem solving, career awareness, presentations and reflections. Social skills such as trust building, bridging the age gap, building positive self esteem and communication, will be goals to work towards. Assessment and reflection will be done through teacher journals and student journals.

Problem-solving and decision-making skills will be redesigned to be infused into the curriculum. In problem-solving the following thinking skills will be emphasized; prediction, brainstorming, classifying, comparing, contrasting, visualizing, evaluating, and analyzing. A particular skill will be emphasized daily. These will be set up to fit into the state's learning outcomes as well.

The teacher's role will be to act as a guide to direct thinking skills and decision-making through questioning and modeling. She will do this through use of cooperative groups, PMIs, "Mrs. Potter's" Questions(see Appendix E), and reflective journaling. Assessment will be recorded on a chart documenting the skill taught. Teacher journals also will be used.

Methods of Assessment

In order to assess the effects of the intervention, a pretest assessing thinking skills will be used initially. In addition, math and reading logs will be kept throughout the intervention. A thinking log will also be used. They will be used for reflection and metacognition and to record problem-solving processes and strategies. Checklists and scoring rubrics that document the skills taught will be developed as part of the process. Progress

will be determined, as well, by use of a posttest given at the end of the intervention. Family math and homework activities will be assessed by checklists and parent documentation. Teacher journals will be used on a regular basis.

CHAPTER 4

PROJECT RESULTS

Historical Description of the Intervention

The objectives of this project were to increase problem-solving skills and decision-making processes in mathematics and language arts. The targeted classes were comprised of one second grade class of twenty-four students and one third grade class of twenty-six students.

The implementation of the objectives was developed in several ways. Materials and activities that fostered problem-solving and decision-making processes were developed for both mathematics and language arts. Many resources were utilized to develop problem-solving. These included; Critical and Creative Thinking, Family Homework, Harcourt Brace Basal Reading Program, Addison Wesley Mathematics, Evan-Moor Math Brain-Busters, Thinking is the Key, and Questioning Makes the Difference.

One of the activities used to address problem-solving and decision-making was the implementation of cooperative learning in both classrooms. Cooperative groups were used three to five times a week. Students were in base groups of three or four students. Base groups were changed every four to six weeks. Strategies for thinking were first modeled by the teacher then practiced in groups. Brainstorming was an important part of cooperative groups. Social skills were also an important component. Each time groups were changed, students learned to work together in that group. Reflection and evaluation also played an important role in cooperative groups. Log books, PMIs, group assessment sheets and "Mrs. Potter's" questions were important evaluative tools and are included in Appendix D and E.

Family math and family homework were other activities which involved students and families in the thinking process. In the third grade classroom, students were given an assignment sheet every Monday with a family homework assignment on the back. They were given all week to complete the assignment with their families. The following Monday about ten minutes were spent discussing the solutions. Most of these assignments were critical and creative thinking activities including logical thinking, problem-solving, deductive reasoning, analysis and drawing conclusions. Samples are included in Appendix D.

Each week in second grade a family math problem was put in the Friday folder. It was placed on a separate piece of paper stapled to the inside of the folder. A place was provided for the solution and the parent's signature saying that the student completed the problem. A record was kept of problems solved on this same sheet. A monthly calendar with these same math problem-solving activities was also sent home. Samples of these are included in Appendix D.

Daily math problem-solving was part of each classroom. Emphasis was on processes and use of a variety of strategies to solve problems. Students in the third grade classroom were given a problem on the chalkboard or large poster to solve. Math log books were used to develop solutions using various strategies. Students recorded their strategies for solving problems. Teacher modeling and questioning were important, particularly early in the year. Strategies and solutions were shared in a variety of ways. Sometimes sharing was done orally. The entire class would share together with the teacher as a guide. At times solutions were shared with a partner or in cooperative groups. Questions included graphing, two step problems, time and money problems, data analysis, logical reasoning, and patterns. Often the teacher reviewed the log book or students checked each others' books when in groups. Sample copies of problems are included in Appendix D.

The second grade students recorded problems in math journals. The problems dealt with the big ideas such as time, money,

estimating, mental math, patterns, and real life situations. Students recorded solutions to these on a daily basis. The problems from the day before were reviewed with solutions and strategies shared. The students often showed strategies with the teacher acting as a cognitive guide. Notebooks were checked daily and a chart was kept to record strengths and weaknesses. Sample sheets of problems are included in the Appendix D.

One of the intervention strategies included an Honorary Grandparent program. A retirement community within walking distance of the school provided a way for students to form a relationship with senior citizens. Monthly visits were made to the facility. Each student was paired with a resident. Social skills, such as trust building, bridging the age gap, developing positive self-esteem, developing and broadening communication skills were part of this program.

Students developed good questioning techniques by using the idea of "Fat" and "Skinny" questions. (see Appendix H). They would interview their adoptive grandparent and then write a story about that person when they returned to the school each month. In addition to interviewing them, students also read stories and shared summaries of the stories from their reading books. Tours were given of the nursing home on one of the visits. One month the honorary grandparents were invited to the school for a play put on by the students. The students brought refreshments and served their friends refreshments after presenting the play. Two months were spent playing bingo. One month the grandparents provided the prizes and the next month the boys and girls provided the prizes. The honorary grandparents also helped the students learn and memorize their multiplication facts as one month they took along their flash cards and practiced together. Several times students presented plays and songs and dances for their grandparents. In March, the students and grandparents knotted a quilt together. Boys and girls were taught by their grandparents how to make the knots. See Appendix H for stories and activities done in this project.

After each visit the children evaluated and reflected on their visits. This usually took some time as they were often quite excited about their visits. Sharing was done orally as well as in their thinking logs. Writing was emphasized through summarizing what they learned. Letter writing was also learned in this manner as thank you letters and invitations and friendly letters were written to grandparents throughout the year. Art and craft projects were also completed in the classroom and shared with grandparents. Students acquired knowledge of history, learned relationship skills, and developed friendships with senior citizens.

The second grade classroom also made visits to area nursing homes. In the fall, they presented a program showing the metamorphosis of the monarch butterfly. The students shared books they had written, sang songs and released butterflies they had raised. In the spring, residents were invited to a spring musical.

Problem-solving and decision-making were further enhanced in the language arts program. Prediction charts were often used before reading a new story. Graphic organizers such as KWL charts, attribute webs, story maps, story wheels, Venn diagrams and story booklets helped students to summarize. These are included in Appendix E. Questioning techniques and oral discussions were used by the teachers to encourage and promote higher order thinking. Students used reading logs to compare and contrast, summarize, analyze, draw conclusions, and transfer learning from the story to their own lives. Cooperative groups discussed, summarized and analyzed stories.

Metacognition became a primary part of all subject areas in this research. Metacognition is defined as thinking about thinking and is done by reflecting, evaluating and assessing. Metacognition became a part of students and teachers learning. Journals kept by teachers and students were excellent ways for students to reflect. Reading, math and thinking logs were tools for evaluating and assessing. Graphic organizers including Venn

diagrams, KWLs, "Mrs. Potter's" questions, and PMIs were excellent tools for metacognition. Samples of these are included in Appendix D.

Assessment of the intervention was done in a variety of ways. Teacher journals were used daily for reflection and metacognition. Checklists and likert scales documented skills taught. Rubrics were also used to assess math problem solving. Samples are included in Appendix G. A thinking skills pretest was given prior to intervention. After intervention the same test was given as a posttest and a sample is included in Appendix A.

Presentation and Analysis of Results

Cooperative learning became one activity used to incorporate problem-solving and decision-making skills into curriculum. Early in the year many activities were done with partners using a procedure called Think, Pair, Share. Team building activities were used to build social skills. Base groups, made up of three to five in a group were formed. Group rules were posted in the classroom. Early in the year group activities seemed to be time consuming as noted in the teacher journal. Groups had difficulty sometimes making decisions about roles. Some were uncomfortable working in groups. Some groups had difficulty completing the task. The teacher had to model procedures and set time limits to complete activities. Short activities seemed to work best.

By the end of intervention, students were spending much less time making decisions on roles. They were better able to focus on the task given to their group. Longer tasks could be given. The teacher could give the task and did not need to spend as much time modeling. In January, the special education teacher who came into the room each day, noted to the teacher researcher that she was impressed with team work she saw and wished other teachers would use it more. The principal observed a cooperative learning lesson as part of an evaluation. She observed how well students stayed on task, how they helped each other when one student's task was more difficult and how students in their groups encouraged each other. The activity was an assembly line activity and included

decision-making and problem-solving in the process. Students in the groups appeared to transfer previous skills learned.

Reflections and evaluations were often done upon completion of an activity either orally or in thinking log books. They were in the form of Mrs. Potter's questions, PMIs, or personal reflections. Reflections showed growth in learning, social skills, problem-solving, and decision-making skills. Improvement in positive self-esteem was apparent to teacher-researchers. By the end of the intervention, students often requested to work in groups rather than individually. Cooperative groups gave students a means to think orally which is also beneficial to some in developing higher order thinking. Ideas from cooperative groups often were far more extensive and impressive than any the teacher could have generated.

Graphic organizers were used to implement problem-solving and decision-making skills. They were used in cooperative groups as well as individually. Teacher-created graphic organizers aided in teaching thinking skills. In the beginning, graphic organizers were used primarily in reading and math. During the intervention, use of graphic organizers transferred to all subject areas. The Venn diagram was used frequently in reading and provided a means of comparing and contrasting characters and events. Life situations were compared before and after reading a story. They were used to compare life long ago and life today. Venn diagrams were a popular way for all children to express their thinking even if they could not read. All children appeared to be successful.

Webs proved to be a favorite with many. They were an excellent means for teaching brainstorming and classifying. Webs were used to teach vowel sounds, vocabulary words, parts of speech, phonics skills, character personalities in stories, holidays, and a variety of other learning areas. After teachers modeled webs, students used them in a variety of ways. As the year progressed students often used webs in cooperative groups. Transfer by students was seen in journals and logs even when not teacher directed. Carry over was noticeable in other subject

areas. Third grade students transferred use of webs when they did their writing assessment on the IGAP tests. Webs appeared to be quite popular with the students especially when introducing new concepts. The children enjoyed completing a web activity and being timed to see how many ideas they could generate in a given time frame.

"Mrs. Potter's" questions were a successful reflective activity after cooperative group lessons. They encouraged students to focus on how well they had done a particular lesson. Posters were displayed in the classrooms with "Mrs. Potter" and her questions. Reflections were done sometimes orally and sometimes in logs.

PMIs were used successfully to analyze stories in third grade. The third grade often evaluated their visits to the nursing home in their thinking logs by using PMIs. They were a popular way for them to share with their cooperative groups what they had learned. Second grade students seemed to have more difficulty with PMIs and needed much modeling and time to do them.

KWLs were a good way to teach predicting. Students had some difficulty with the second and third columns of the KWL. The third grade teacher had better success with them if the students wrote questions in the second column rather than statements on what they wanted to know as they previewed the story in reading. After reading the story, they answered the questions in the learned column. This helped students to more successfully focus on what they were reading and what they found out although some did experience difficulties. By the end of the intervention, most third grade students demonstrated improvement. Many second grade students had difficulty with the second column in particular, as they did not always understand or know what they wanted to learn. KWLs appear to incorporate more abstract learning and possibly are more successful in higher grades.

Improvement in problem-solving and decision-making in language arts was noted and documented on checklists and on a thinking skills posttest. Predicting was a skill successfully

used before reading a story to give the students a focus for reading. Teacher researchers noted how proficient students became in recording predictions in their log books before reading a story. Improvement was noted in students ability to predict.

At the end of each story, summarizing was a useful way to problem-solve in each story. In second grade, two-thirds of the students were able to do this at some time. Much modeling and time was used at the beginning of the intervention for this. To conclude, summarizing still remains difficult for second grade students and most third grade students. Students improved in their ability to summarize and most enjoyed doing a variety of activities to summarize. Summarizing was done by using story maps, booklets, storywheels, and cooperative group activities. More mature children appeared to be better able to summarize and see the whole picture in a story or lesson. In order to see improvement, it was necessary to practice and work on this skill with each story.

The intervention appears to have had a positive effect on the targeted thinking behaviors in math problem-solving. Of particular note is the incidence of problem-solving in the specific areas. At the beginning of the second grade year, only about twelve to fourteen journals were completed each day. The children were frustrated to the point of tears. As the year progressed and more strategies were modeled, more children completed their journals. Participation increased and sixteen to eighteen journals were being completed each day. Random samples from a checklist that was maintained throughout the intervention indicated six children showed little improvement in real life problem-solving situations. The majority was successful with the rest of the areas which included time, estimating, patterns, mental math, and money. About six children experienced difficulty using strategies to solve problems. The teacher researcher concluded that about six children had very strong problem-solving skills. The immature children often were unsuccessful and experienced difficulty. This may be due to short attention and

inability to see the "big" picture. Growth was noted in the majority of the students.

The intervention in math problem-solving appeared to have a positive effect in the third grade also. Strategies were recorded in math logs. Students were expected to share how they arrived at their answers. Emphasis was on the process. Many experienced frustration early in the year. Tears were shed and erasures were made until the paper was torn. Students were solution focused rather than process or strategy focused. Two step problems proved to be extremely difficult. Modeling by the teachers was extensive and time consuming. As the year progressed the students became the models and the teacher became a guide. Improvement was noted in the teacher journal as the intervention continued. The teacher-researchers noted when students worked individually, the immature students often gave up or got stuck and appeared to be unable to function at a higher thinking level. This was contrasted with about eight students who were highly successful and enjoyed problem-solving. Sharing strategies and solutions with each other was an important part of this activity. Children with higher thinking skills often became the teacher. Teacher researchers have observed that exposing students to a variety of ways to solve problems has been an excellent way of offering each child a way to think at their ability level. Some students progressed very little but teachers feel they have still been given a foundation and may in the future develop and use ideas and strategies given to them.

Family homework and family math gave children opportunities to solve problems with their families. Good response from parents was noted in both classrooms. Parents were often solution oriented and came in to ask for answers to problems. Parents' attitudes toward problem-solving and math were sometimes reflected in their child's ability to complete assignments. According to checklists, students who experienced difficulty with problem-solving and decision-making did not complete homework assignments. Many students in both grades enjoyed completing these assignments.

They taught their parents strategies and enjoyed sharing parents reactions to problems. Teacher researchers hope to continue this program in the future as it is a good bridge between home and school.

The intervention appeared to be successful as measured by the posttest. Figure 1 compares pretest and posttest of second grade students. Figure 2 compares pretest and posttest of third grade students. The graphs may indicate that the second grade teacher emphasized patterns while the third grade teacher may have emphasized language problem-solving. The graphs also indicate a marked difference in higher level thinking ability between second and third grade. Age may be a factor in this difference. The third grade pretest scores and the second grade posttest scores were very closely aligned. It appeared that third grade students were able to successfully infer words from definitions and word parts. Second grade students may not have developed this skill yet.

It appeared that second grade scores showed improvement in patterns and math problem-solving. Patterns had the biggest improvement. Perhaps this was due to the daily pattern problem-solving. A marked increase was noted on two words derived from definitions and word parts. A regression was noted on seven of these words. Perhaps this may be due to the time when the test was administered. The students were excited, as the test was given just before an assembly in the afternoon. It appeared second graders are able to find words that do not belong in a sentence and change them into a sensible sentence. These areas seem to have high levels of achievement.

Third grade posttest and pretest were compared in figure 2. All questions showed a marked improvement. Five of the questions doubled with the amount of correct responses. Two questions had one hundred percent correct responses. The question on two step problem-solving had a one hundred percent gain jumping from seven to fourteen in the two scores. The graph shows strong growth in all areas for third grade.

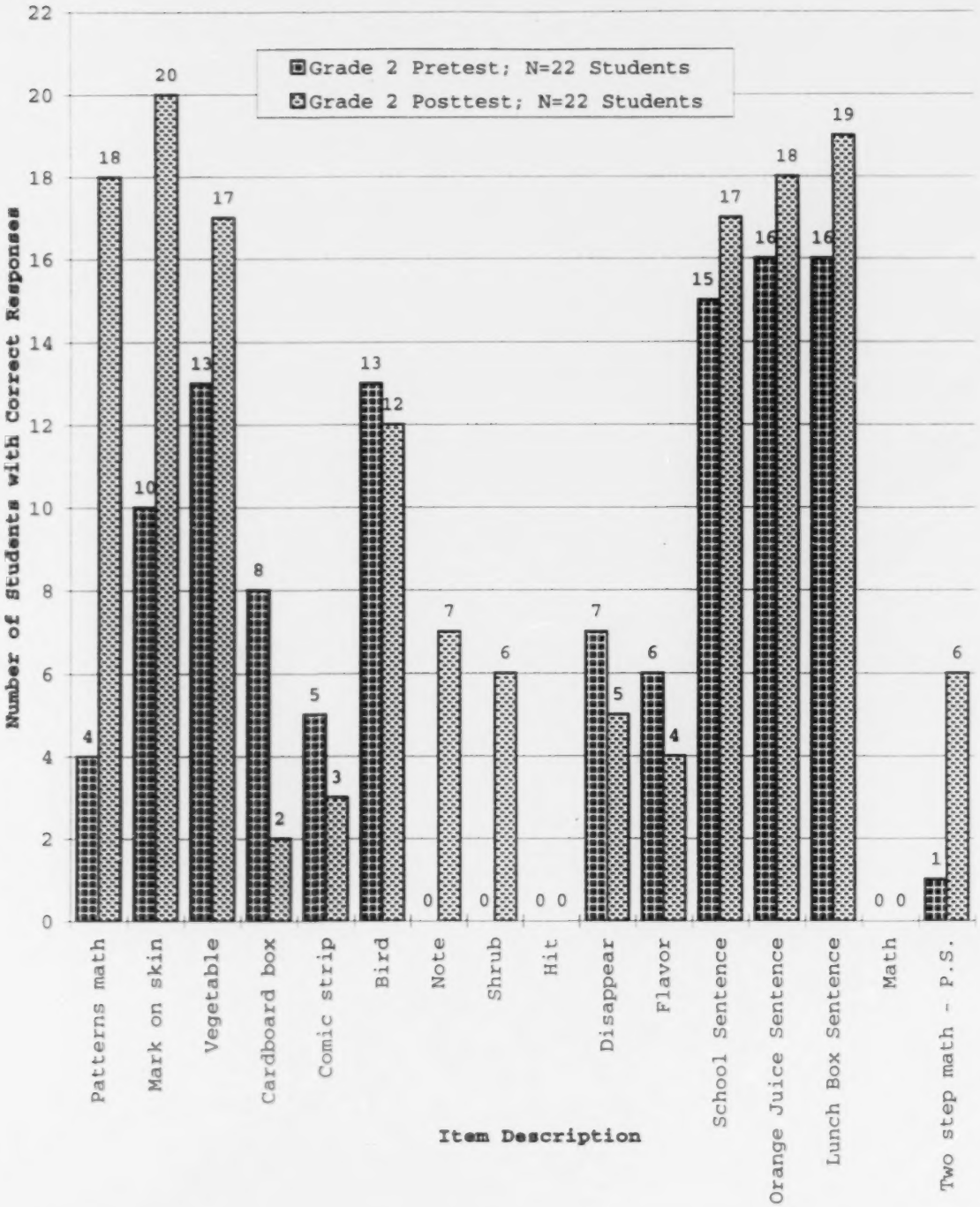

Figure 1. Pretest and posttest on thinking skills: Number of Second Grade students with correct responses for each question.

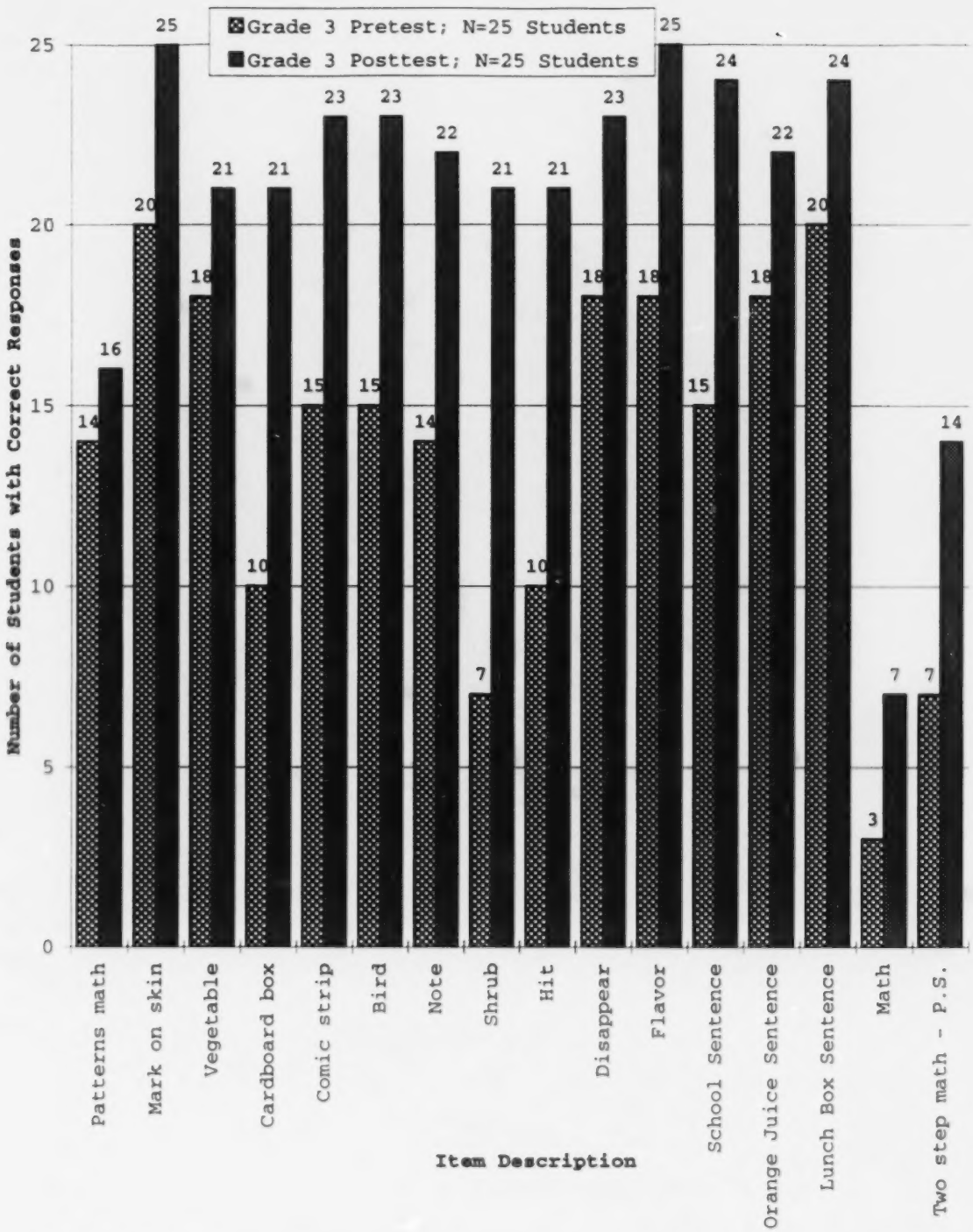

Figure 2. Pretest and posttest on thinking skills: Number of Third Grade students with correct responses for each question.

Conclusions and Recommendations

Based on the presentation and analysis of the data on improving higher order thinking skills, the students showed marked growth in their ability to solve problems and make decisions. The use of cooperative groups was a way to teach social skills together with the higher level thinking skills and was beneficial. Cooperative groups served as a tool. Children created more and better strategies and solutions through cooperative groups than the teacher could have generated. Cooperative groups gave students opportunities to think out loud, and for more to share their thoughts orally. Learning the skills of problem-solving and decision-making in groups and teams, provides a foundation for being a part of a team work force in their adult years.

Graphic organizers, family homework activities, specific problem solving activities all served as vehicles through which problem-solving and decision-making skills could be taught. Many graphic organizers proved to be useful tools for teaching the thinking process. Transfer of higher order thinking began to occur automatically and became infused into the curriculum. Students used strategies in other subjects and areas also.

Students developed more positive self-esteem. All children learned to think, from the "gifted" to the "nonreader". Students became comfortable and enjoyed working and solving problems in groups. Students demonstrated tolerance and understanding of each other's ideas and strategies. Children in the third grade class learned to love and respect senior citizens through the visits to the nursing home. The caring and love that developed was beautiful to observe. These interactions enhanced positive self-esteem for the children and the senior adults. Many positive comments and affirmations were given by parents and persons in the community. The nursing home has also requested the program be continued next year.

The teacher researchers would recommend that future research on higher order thinking skills be limited to one area. This might be one subject or project. The researchers covered too

broad an area. It was quite time consuming and hard to stay organized. The best research came out of each researcher's strongest area of intelligence. The research helped identify the strongest gifts of each researcher. Weak areas also became more apparent. Researchers also became "thinkers."

One of the recommendations of the teacher researchers is that schools begin to teach higher order thinking skills to all children. A systematic plan is needed starting with the youngest and moving up though the grades. Textbooks which emphasize thinking, should become a part of the curriculum. Initiation of thinking should begin with practice in staff development. This would include learning how to use cooperative groups, graphic organizers, and modeling strategies. After experiencing these, teachers would infuse these into their programs.

Parents need to be made aware of the value of teaching thinking. Parents found that they were not always good thinkers themselves. The adults of tomorrow will need more than memorization of facts and information to solve problems and make decisions in tomorrow's world. Everyone has the responsibility to learn how to think and to transfer that skill to the adults of tomorrow. Traditional methods of instruction need to change as higher level thinking skills become infused into the curriculum.

Intelligence is broader than memorization of facts. Robert Sternberg comments about successful intelligence. Successful intelligence includes analytical thinking, creative thinking, and practical thinking. "People who possess successful intelligence know how to make the most of what they do well and are able to find ways to work around their limitations. They are motivated, controlled, persevering, and independent" (Sternberg, 1997,p.1). Children's minds are not receptacles in which facts can be poured. Children's minds need to become a "home for thinking." The teacher-researchers have noted their own minds have become a "home for thinking." Out of that "home" has evolved more confidence, more positive self-esteem, and a stronger awareness of the need for teaching the thinking process to all.

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Thinking Skills Test

Please complete the pattern.

1 I 2 3 ___ ___ ___

Please complete

2. Mark on skin _____car

3. Vegetable car___ ___ ___

4. Cardboard box car ___ ___ ___

5. Comic strip car___ ___ ___ ___

6. Bird car ___ ___ . _ ___ ___

7. Note sent through the mail ___ ___ ___ ___ car___

8. Shrub bus___

9. Hit ___truck

10. Disappear Van ___ ___ ___

11. Flavor Van ___ ___ ___ ___

These sentences have some funny words that do not make sense. Underline each word that does not fit. Write a word that does above it.

12. This evening when I woke up to go to school, I raced to the kitchen for breakfast.

13. I opened up the television and took some orange juice.

14. My lunchbox had a peanut-butter-and -hammers sandwich in it.

Write the answer in the blank

15. Which is heavier, a pound of steel or a pound of lettuce?_____

16. A spider fell into a five-inch coffee can. Each minute it managed to climb two inches, but fell back one inch immediately afterward. How long did it take the spider to reach the top?

Staff Survey

This study is being conducted by Gerry Schrock, (third grade teacher). I am currently a student in the Field-Based Masters Program at St. Xavier University. One of the purposes of the study I am conducting is to investigate the opinions of teachers regarding the topic of students higher order thinking skills. Your participation in the survey is strictly voluntary; there are no penalties if you choose not to participate. If you decide to participate the information you provide will remain completely anonymous. You do not need to sign your name to the survey. The survey will be part of the action plan I will be working on all year entitled Improving Students Problem Solving and Critical Thinking Skills. Thank you for taking the time to complete the attached survey. I appreciate your input.

Gerry Schrock

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Rate from 1-5 the following questions. (5=high ability, 1=low ability).

(Third Grade, Rate 1-5)	(Second Grade, Agree/disagree)
1. Rate your students' ability to solve problems.	1 2 3 4 5 Agree/disagree
2. Rate your students' ability to brainstorm.	1 2 3 4 5 Agree/disagree
3. Are they able to identify the problem when they read a story?	1 2 3 4 5 Agree/disagree
4. After conducting an experiment in science can they draw correct conclusions based on what they have done?	1 2 3 4 5 Agree/disagree
5. Can they use more than one strategy to solve a math problem?	1 2 3 4 5 Agree/disagree
6. Can students draw conclusions based on verbal or written facts?	1 2 3 4 5 Agree/disagree
7. Do you feel students transfer problem solving strategies to real life experiences?	1 2 3 4 5 Agree/disagree
8. Are your students able to identify patterns in numbers, words, objects, and pictures?	1 2 3 4 5 Agree/disagree
9. Are your students able to construct verbal expressions of their thinking?	1 2 3 4 5 Agree/disagree
10. Can your students reflect verbally and in writing, on their thinking?	1 2 3 4 5 Agree/disagree
11. How important do you feel it is that our school implement a schoolwide thinking skills program?	1 2 3 4 5 Agree/disagree

Parents Survey

This study is being conducted by Gerry Schrock, (third grade teacher). I am currently a student in the Field-Based Masters Program at St. Xavier University. One of the purposes of the study I am conducting is to investigate the opinions of parents regarding the topic of students critical thinking skills. Your participation in the survey is strictly voluntary; there are no penalties if you choose not to participate. If you decide to participate the information you provide will remain completely anonymous. You do not need to sign your name to the survey. The survey will be part of the action plan I will be working on all year entitled Improving Students Problem Solving and Critical Thinking Skills. Thank you for taking the time to complete the attached survey. I appreciate your input.

Gerry Schrock

PARENT SURVEY

Please indicate if you agree or disagree with the following statements.

1. Television helps children to develop higher order thinking.

   agree disagree

2. Computers engage children in higher levels of thinking.

   agree disagree

3. The teacher's task is to teach higher order thinking.

   agree disagree

4. Parents are involved in teaching thinking skills to children.

   agree disagree

5. An answer to a problem is more important than the explanation of the process.

   agree disagree

6. Daily conversation and exchange of ideas are a high priority at home.

   agree disagree

7. Reading is a daily part of your home life. agree disagree

8. Discussions about reading and television programs are important at home. agree disagree

9. Generally test scores are very important. agree disagree

10. High test scores indicate high thinking skills. agree disagree

Please feel free to comment on ways you might teach thinking skills in your home.

_____

_____

_____

INTERVIEW QUESTIONS ON THINKING SKILLS FOR ADMINISTRATORS

1. To what degree do you feel high test scores indicate high levels of thinking?

2. I know you value higher level thinking. Do you think these skills are being adequately addressed in our school? To what degree?

3. What are your thoughts about how thinking skills can be best addressed in the curriculum?

4. What kind of support do you think our staff needs in order to increase or improve thinking skills in the student?

Doggie Bowl Activity

(Bonding Activity)

This activity is the last team building activity I do with my cooperative groups. I generally do about five hours of bonding activities (please ref. Other Activities) prior to the teams being assigned the Doggie Bowl Activity. This activity is an adaptation of an activity used to enlighten teachers about the difficulties of being a handicapped student in a regular education room.

Step One Students are shown a finished doggie bowl (see ditto next page) and instructed to create a name for their Doggie Bowl Company. Ex. Taste Good Bowls. Time limit 4 minutes.

Step Two Students are given a demonstration by the teacher on how to complete a doggie bowl (cut, fold, and tape). (See ditto Doggie Bowl).

Step Three Students are given five minutes to complete one doggie bowl. Discuss finished product.

Step Four Teams are asked to estimate how many doggie bowls they can complete in 25 minutes. Post number on board.

Step Five Roles are assigned, and team members are instructed not to assist other team members with their tasks. Roles (Materialman, helper, encourager) (cutter), (folder), (taper). You may now have Materialman collect materials.

Step Six Time is set for 25 minutes. Team members begin! After seven minutes, the teacher blows a whistle to

stop and explain that a terrible accident has happened, all cutters injured their left hand. Teacher tapes cutters' left hands to the top of the tables. Materialmen may help cutters but cannot touch the scissors. Whistle blows to start again. Seven minutes later, whistle is blown again. Tapers have been blinded in an accident. Tapers are blindfolded. Materialmen can help tapers but can't tape themselves. Whistle blows to start again. Seven minutes later, whistle blows again. Folders broke three fingers on each hand, tape three fingers together on each hand of the folders. Whistle blows to start activity. Finish time limit. Post number of completed bowls next to estimate.

Step Seven Discussion - List Problems - List Solutions. Discuss handicaps. Possible questions, What did the group do to compensate for the injured members? How did you help each other? Did you feel how important your help to each other was? Doesn't this transfer to remind us to help someone when doing other tasks?

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Social Skills Cooperative Lesson

Objective: Students will formulate class rules that promote health,safety, and happiness in the classroom.

Brief description: students will formulate rules for the classroom.

Stimulus: I will put posters around that feature safety,happiness, and health in the classroom. The students will have time to look at them.

Activity: First the student will think of rules we need in our classroom. Next,they will share with a partner.

Follow-up: As a class we will discuss their ideas and put them on a charter. students may sign the charter if they agree with them and want to follow them.

Evaluation: What did they like? What was interesting and what could be different?

INFANT SELF/GROUP ASSESSMENT SHEET

Name of group members

_____

_____

Date _____

Activity _____

(TEACHER TO COMPLETE CRITERIA)

Colour the face to show how you worked

Criteria	**great**	**okay**	**not so well**
_____			
_____			
_____			
_____			
_____			
_____			
_____			

GROUP ASSESSMENT

Group Member	*Skill*	*Feedback*
	Taking Turns	
	Listening	
	Encouraging	
	Staying on Task	

GROUP ASSESSMENT SHEET

Names of group members

Date _____

Activity _____

List the things your group did well

What could your group do better next time?

Thinking for Themselves

GROUP ASSESSMENT SHEET

Names of group members

Cameron, Justine, Andy, Nicole

6

Date 3/25/97

Activity Assembly Line

List the things your group did well

We coroperated, we didn't talk loud, got a long well, we all did the same job, we didn't argue alot.

What could your group do better next time?

We won't talk much, we will not disturb other groups.

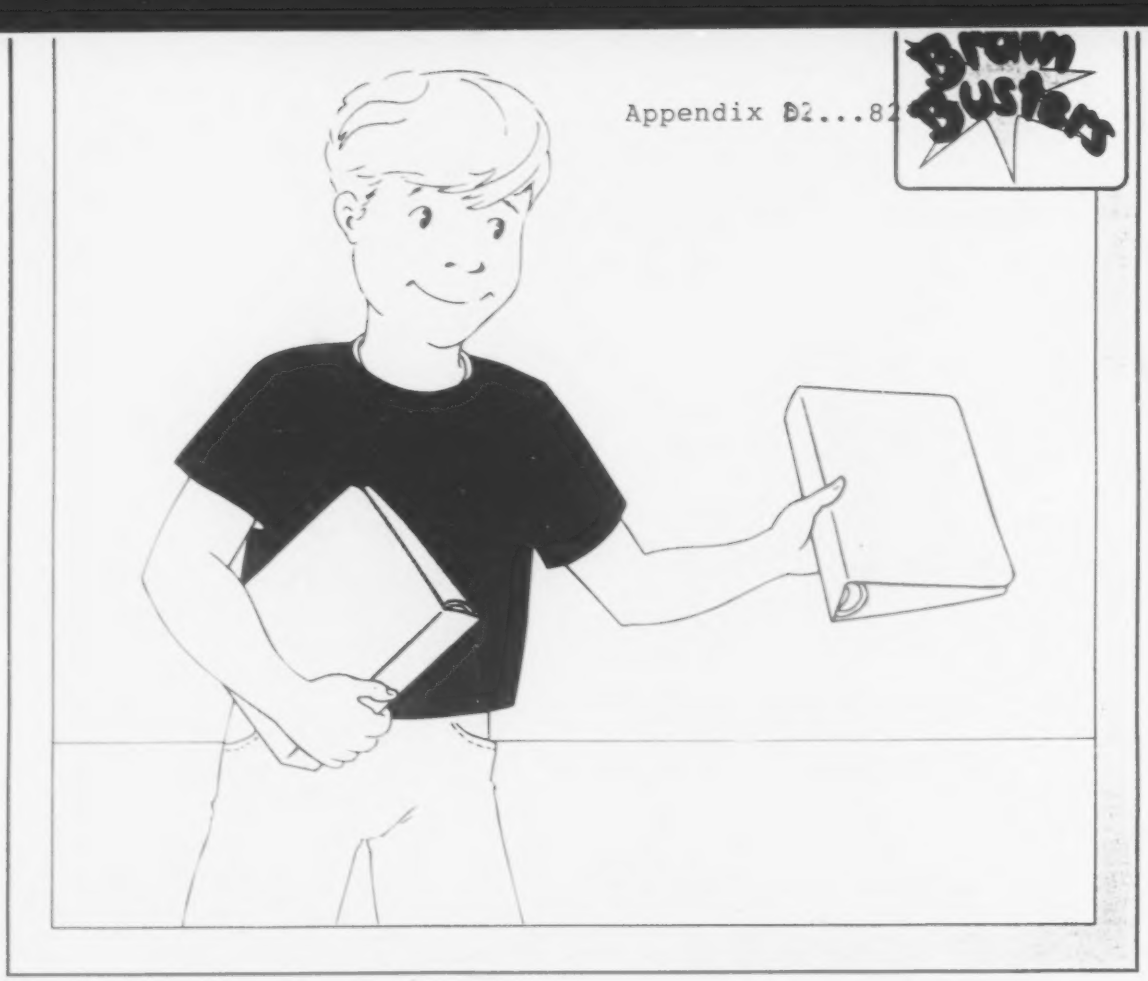
MATH LOG

1. Write the number problem.

2. Draw the problem.

3. Explain the problem to your partner.

4. Write the problem correctly with the answer and label it.



Notebooks sell 5 for $3.00.

How many notebooks did I buy if I spent $30 on notebooks?

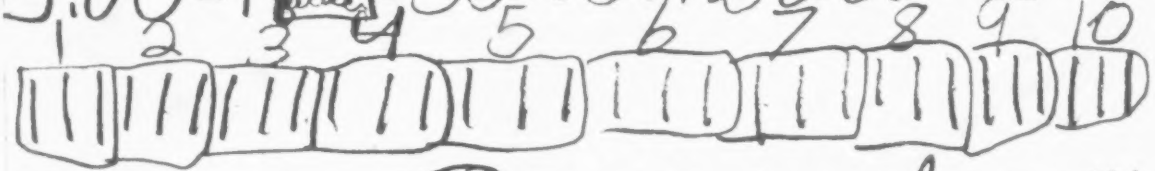
© 1993 by Evan-Moor Corp.

allison l.

23

April 7, 1997

$3.00 = 1 [sweater] $30.00 = notebooks.



We got 10 notebooks with $30.00!

10 × 5 = 50

First I wrote down my data. Then I thought there some stratages I could use. Next I thought I would draw 30 lines to repusint 30 dollors. So I did. Froth I derived them into grops of three. Finaly I put numbers above the grupes. The numbers were 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10. Then I wrote mi answer, 10. Last I wrote 10 × 5 = 50. I figured it was 50.

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Problem Solving

1952 Today show started

How many years ago was that?

Jan. Patterns

Sam puts 1 penny in Day 1
2 pennies in Day 2
4 pennies in Day 3

How many by Day 5

Mental Math

Appendix D...84

4 dimes

Money

10¢ + 1 nickle ___¢

W

Estimate

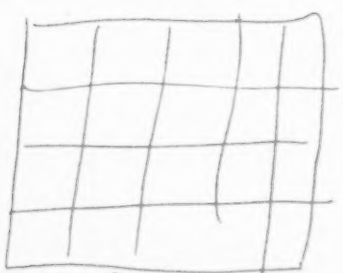
How many quarts of drink. Each child 1 cup.

Time

11:30

___ min after ___

Problem Solving



Peoples 1st Names

Patterns

□ □□ □□□ ___

Mental Math

9 dimes

Money

75¢ + 1 dime

Estimate

No of eggs. ~~5 eggs~~

5 children to 1 egg

Time

6:45

___ min after ___

Mrs. Potter's Questions

1. What were you supposed to do?
2. What did you do well?
3. What would you do differently next time?
4. Do you need any help?

Allison A

Mrs. Potter Questions

1. We where expected to read the story and due our jobs.
2. We answred and made up questions well.
3. I whod be chairmen and keep it moving along we whod take less time and not take so much time.
4. We need some help on chusing jobs and other things

What I Did we shood get an E-

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FAMILY MATH

Date	Activity	Completed? yes/No	Comments (optional)

Marble Recipe

1 1/2 c. flour
1 c. salt
1 c. cornstarch
Warm water
Paint and paintbrush

Keep
America Beautiful Month
Lawn and Garden Month
Mathematics Education Month
Month of the Child
Humor Month
Knuckles Down Month
(use marbles)

April 1997

PTO Carnival 11:0 3:0

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
	Ponce de Leon discovered Florida	April 1 Fool's Day Lirpa Loof 400 years old what year did it start?	First White House Easter Egg Roll Children's Book Day Hans Christen Anderson's Birthday	3 Washington Irving Birthday	Carnival Kick-off 4 Postest Lesson 28 Report Cards Home	If April Fool's Day is 400 years old. What year did it start? 5 Birthday Booker T. Washington
North Pole Discovered 6 Garden Week	Pretest Lesson 29 7 World Health Day	8	9	Siblings Day 10 P/T Conferences	Postest 11 P/T Conferences	Find 12 ways to get to 11. 12 Astronomy Day
Library Week 13 Week of the Ocean Week of the Young Child The mask of Horsa Birthday	Pretest Lesson 30 14 Wildlife Week Webster's First Dictionary Published	Rubber Eraser Day 15	Thank You Librarian Day 16 Wilbur Wright Birthday	17	Postest 18 Paul Revere's Ride	Hans Christen Anderson is 191 years old What year was he born? 19
Reading Is Fun Week 20 Sky Awareness Week	Pretest Lesson 31 21	Earth Day 22 Anniversary Passover	23	24	Postest 25 Arbor Day	Double your marble recipe. Write the new recipe. Could you triple it? Birthday of Audubon 26
Kite Flying Frisbee Fling Lubbock, TX Family Reading 27	Pretest Lesson 32 28 CRT Testing Week Great Poetry Reading Day	29	May Eve Homestead Day 30	94	125 years old	

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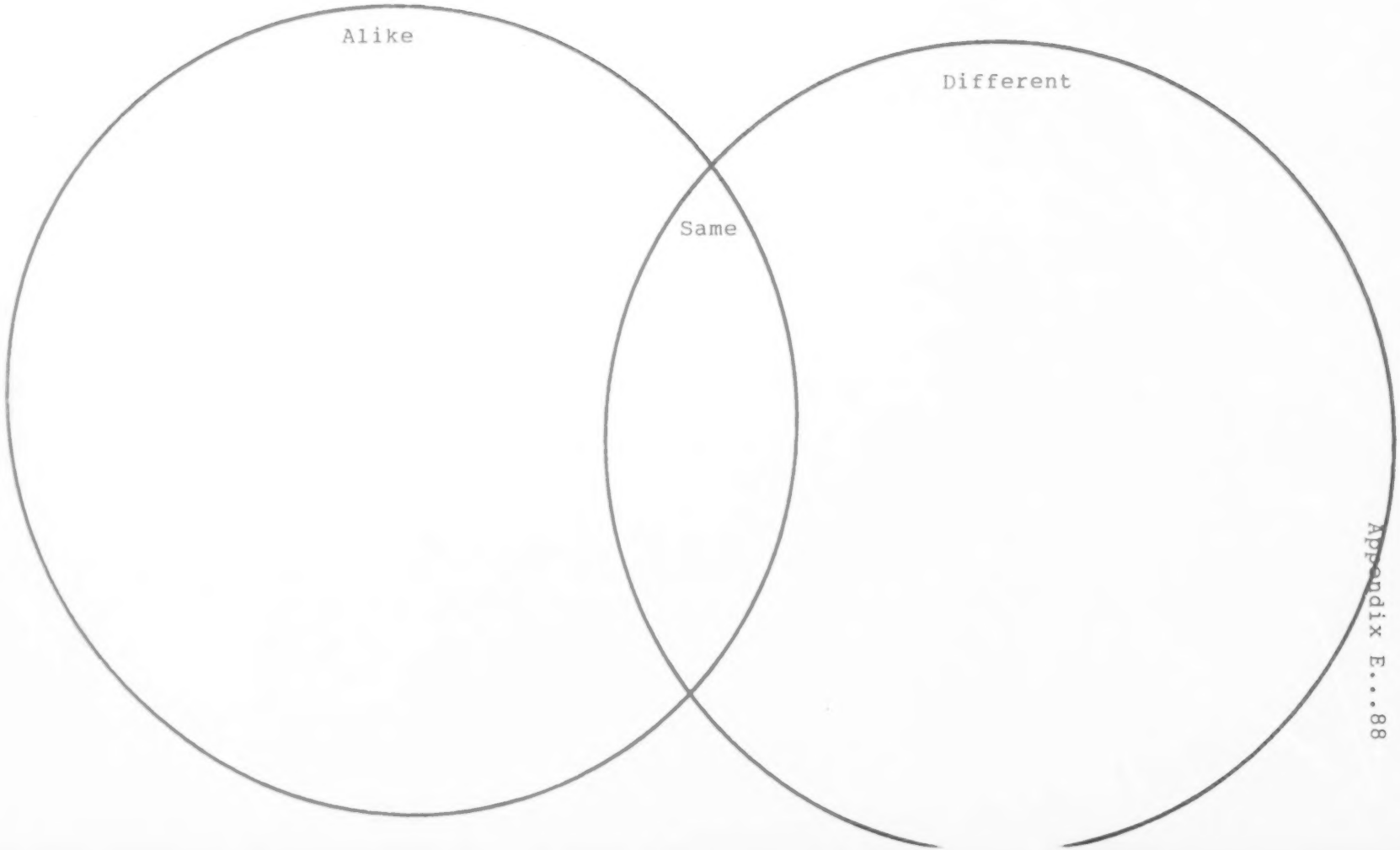
VENN DIAGRAM



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Andy 24

some

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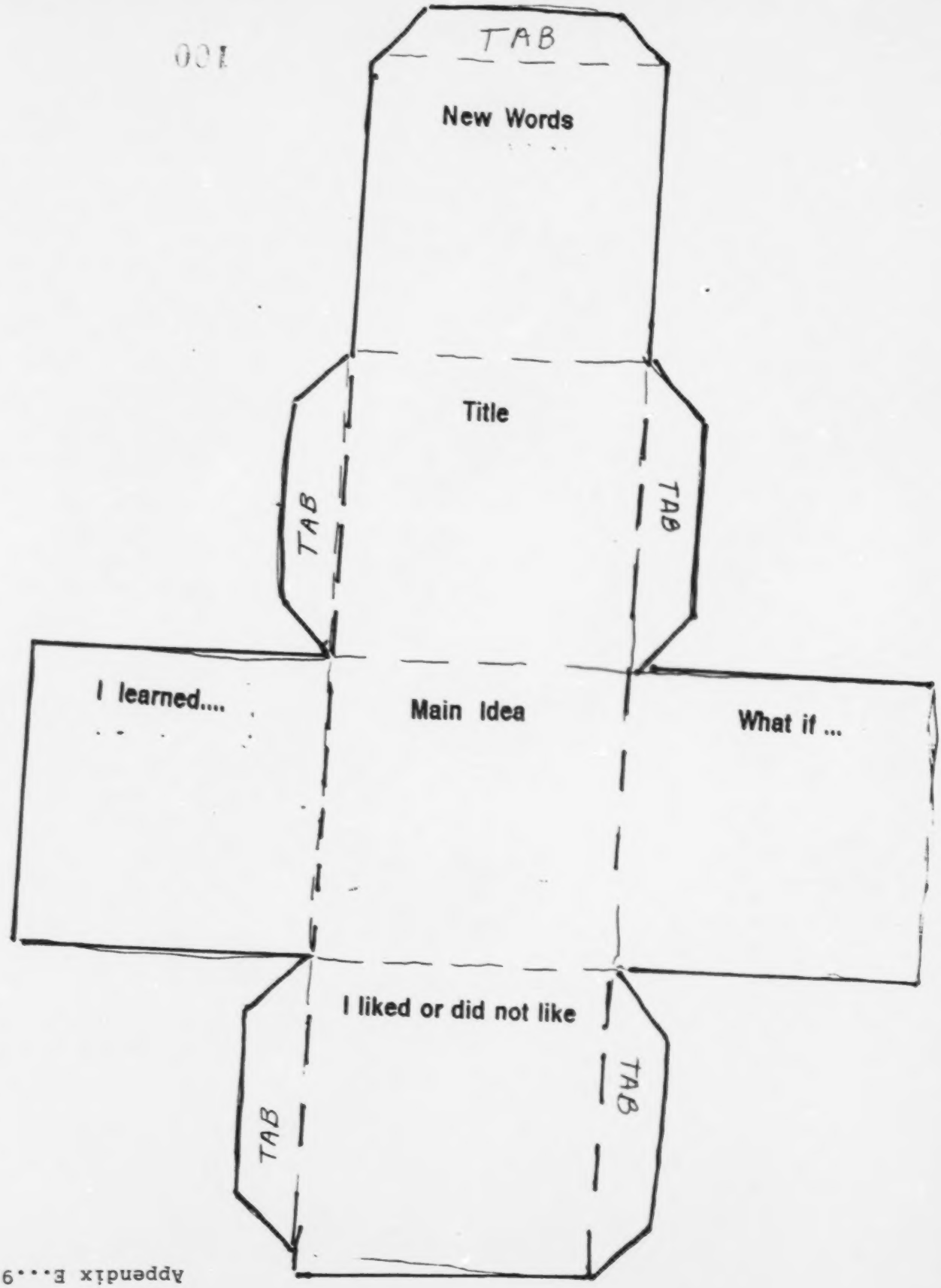
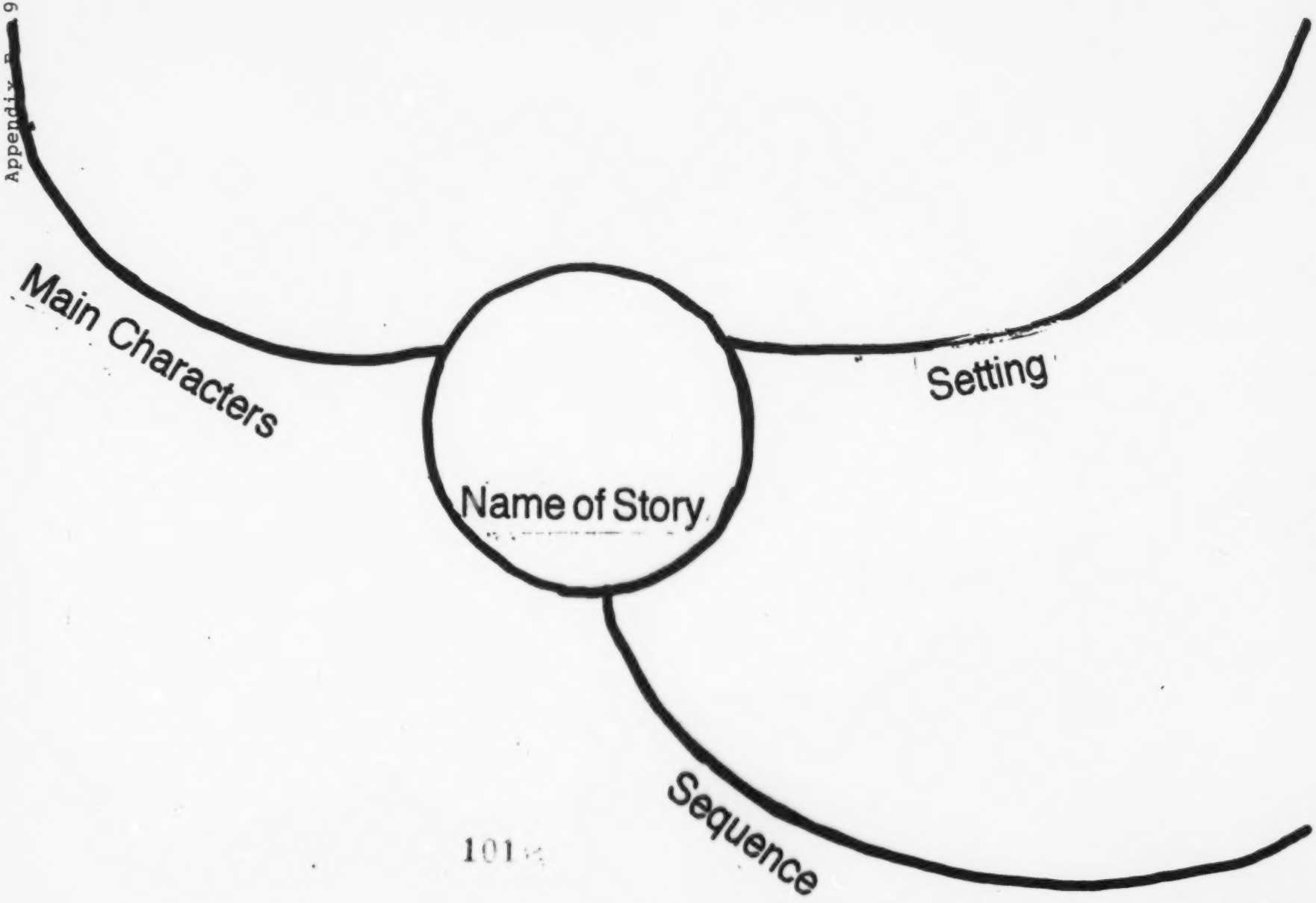
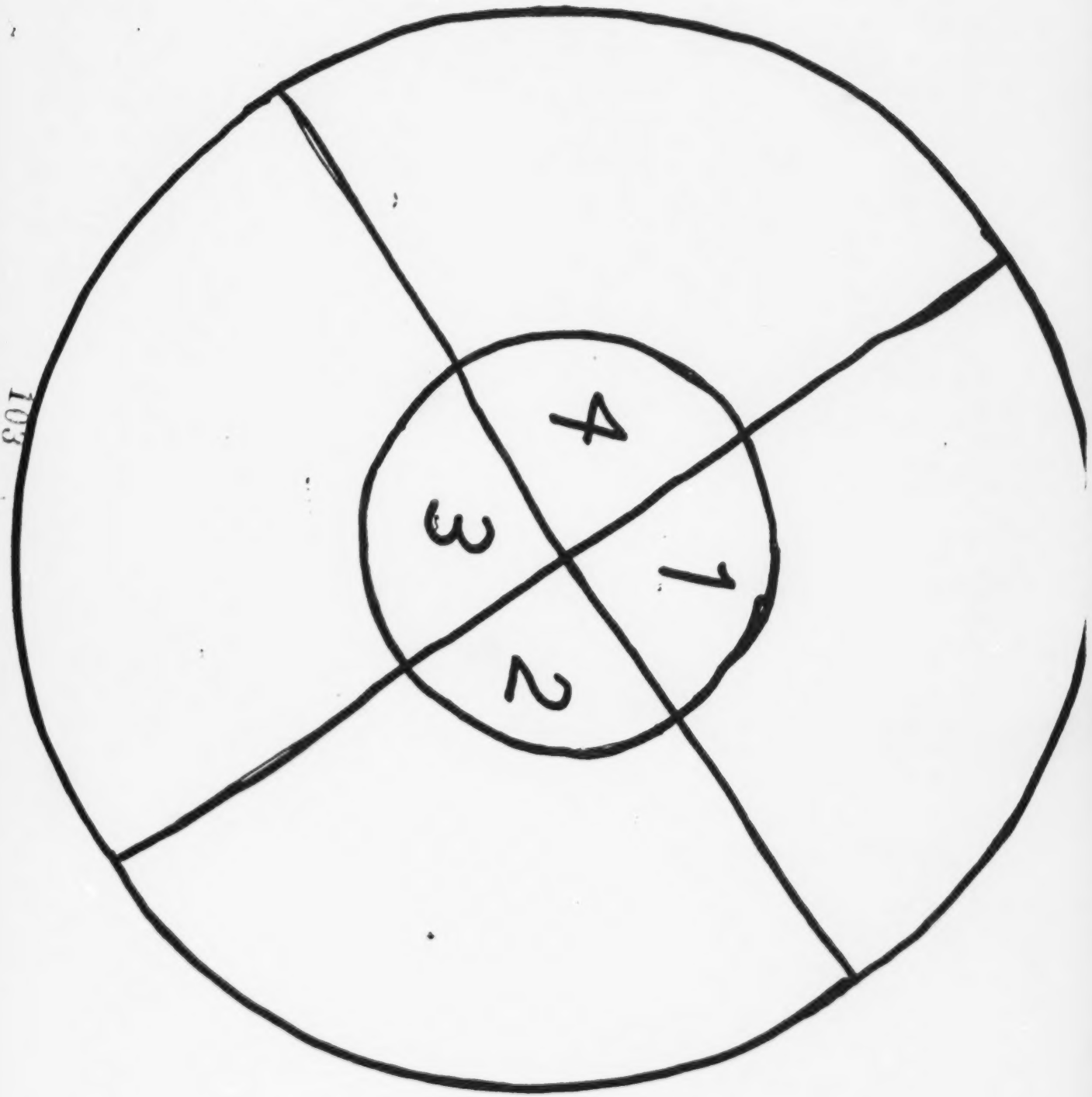
FAT?	SKINNY?
1.	1.
2.	2.
3.	3.
4.	4.

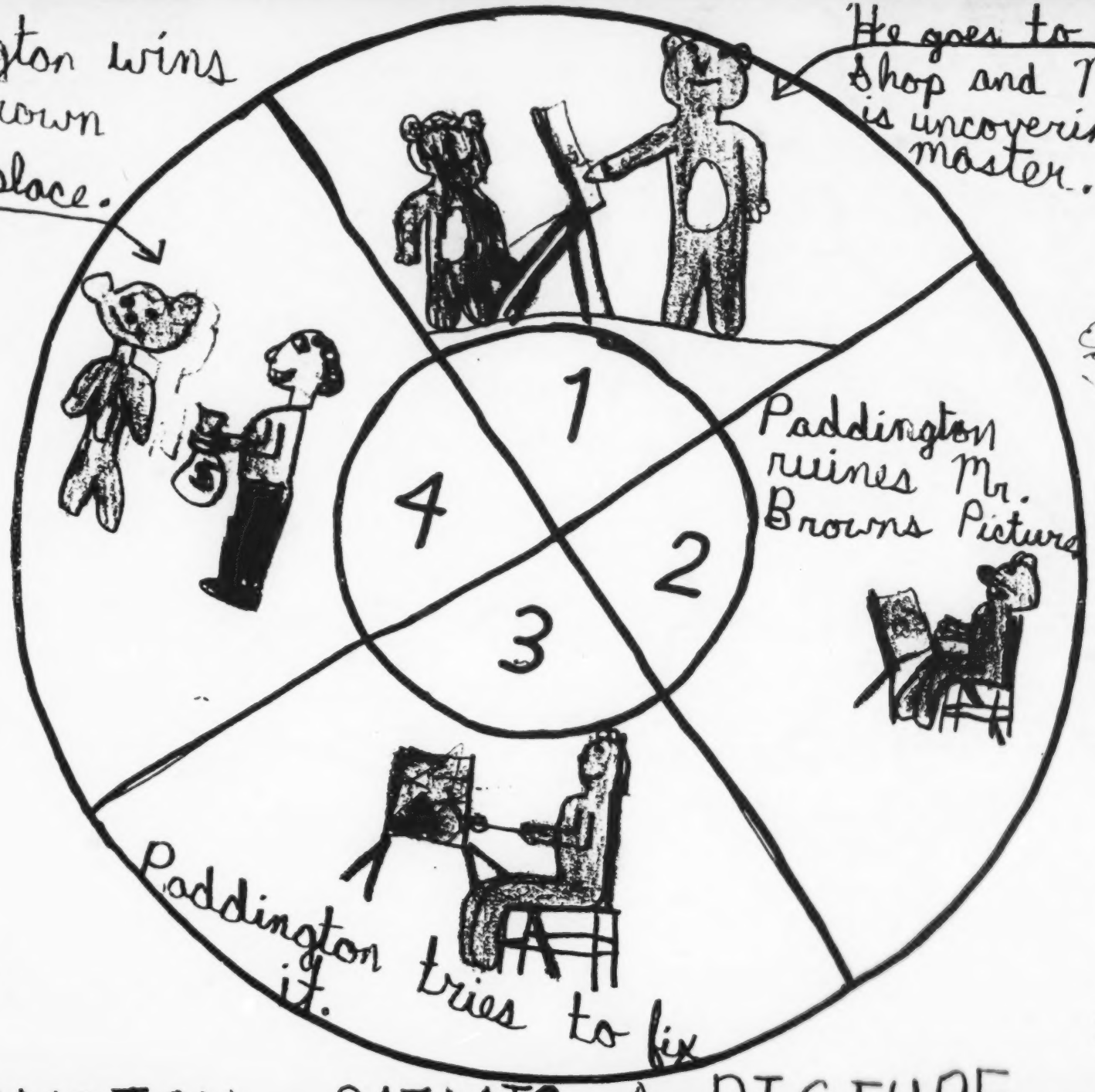
Appendix E...90

99


TAB
New Words
Title
TAB
TAB
I learned....
Main Idea
What if ...
I liked or did not like
TAB
TAB


Main Characters
Setting
Name of Story
Sequence


4
3
1
2



105

106

Appendix E...94

Prediction Chart

What I Predict Will Happen	What Actually Happened

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What I Know	What I Want to Know	What I Learned

WHAT I LEARNED
WANT TO KNOW
Know

K

- he was famos
- he planted apple seeds - he all most dide once he made a lot of frinds
- he was a good person - he helped the pioners - he wored a pan on his hede -

W

- I want to know how old he was when he said - why he did it ? - how he god sick - how he died - where he lived - how has the story exarated -

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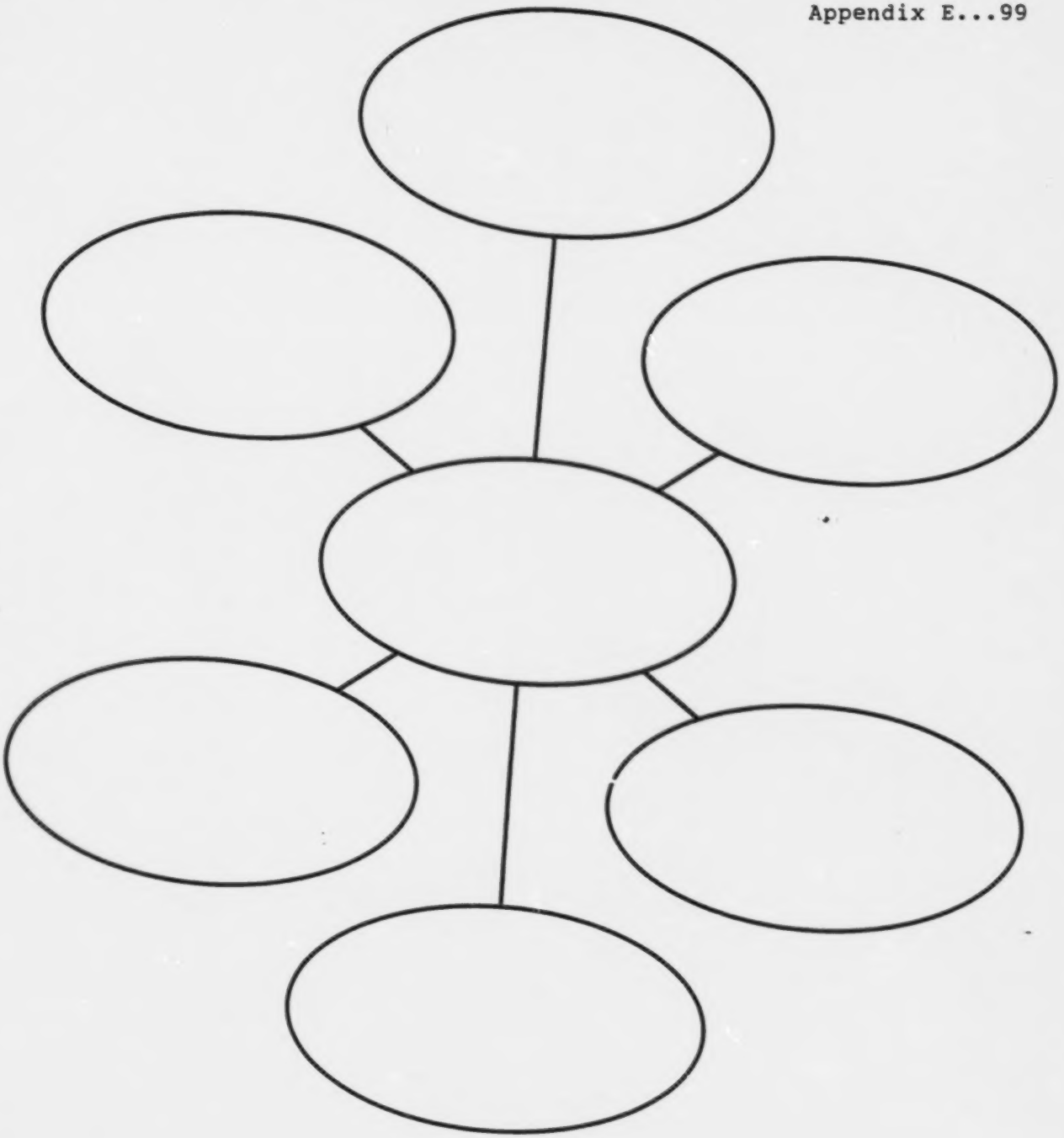
L

- When he lived - how he died - how the story has erarated -

Appendix E...98



Name _____

Process Skill Activity

Find the Pattern

1. Look at the patterns. Draw the next pattern in the box.

2. Complete the number pattern below for each design above.

1	2	_____	_____
1	2	_____	_____
1	2	_____	_____

3. Look at the number patterns below. Complete each pattern.

3	4	___	6	___	8	___	10
1	1	___	1	___	1	___	1
3	4	___	6	___	8	___	10

4. Choose one of the number patterns above. Draw a design that shows the number pattern in the box below. Use any two of these shapes to draw your design.

Discover Science 3 © Scott Foresman and Company

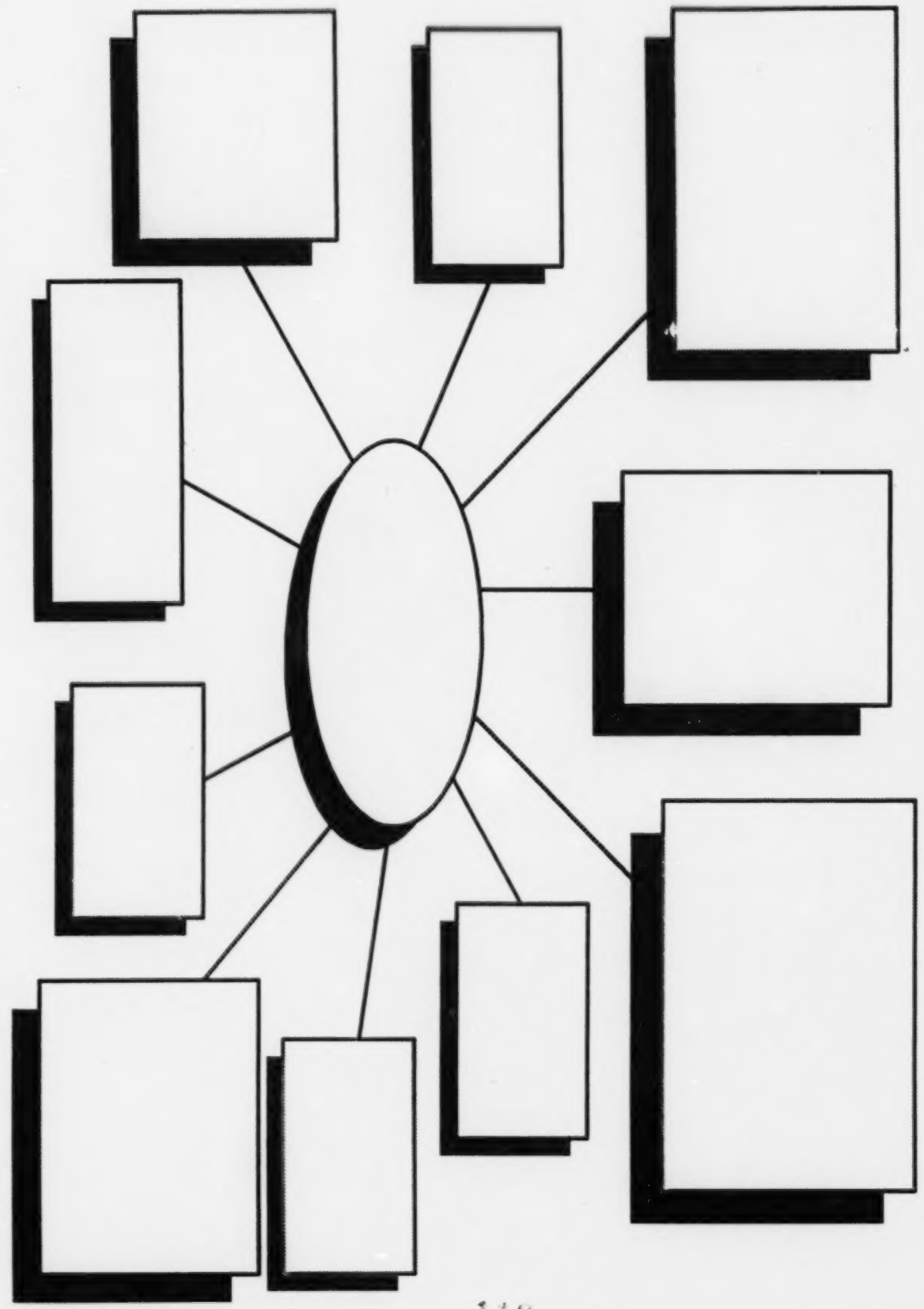
Ramona Quimby 9/23/9.

Excellent summary!

I enjoyed reading it E! ☺

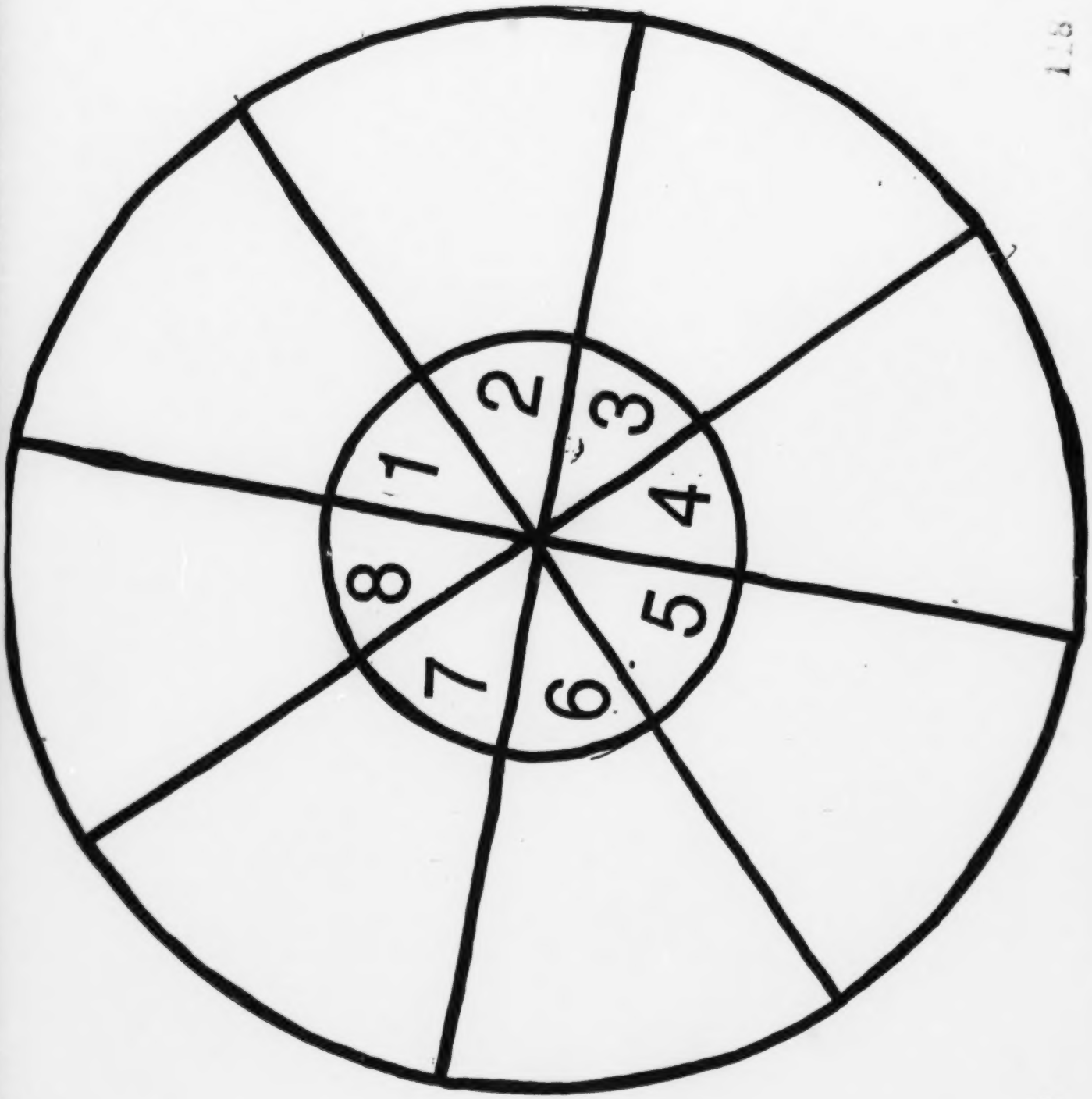
Ramona is a girl with an imagination and a curiosity. She i On the first day of school she meets a boy and nicknames him yard ape. Guess what? After she had to go to her friend Howie's house and play with four year old Willa Jean. At school she get egg in her hair. Beezus and Ramon didn't like tongue so they had to cook dinner the next day. While they were cooking dinner they made a big mess. Ramona threw up in class because she ha the stomach flu. She got letters from her class Ramona had to give a book report and she made it very neat and interesting. That Sunday something very interesting happened to the nice Quimb family. I liked this book very much. I'm like Ramon because I like to Roller skat

Date: _____

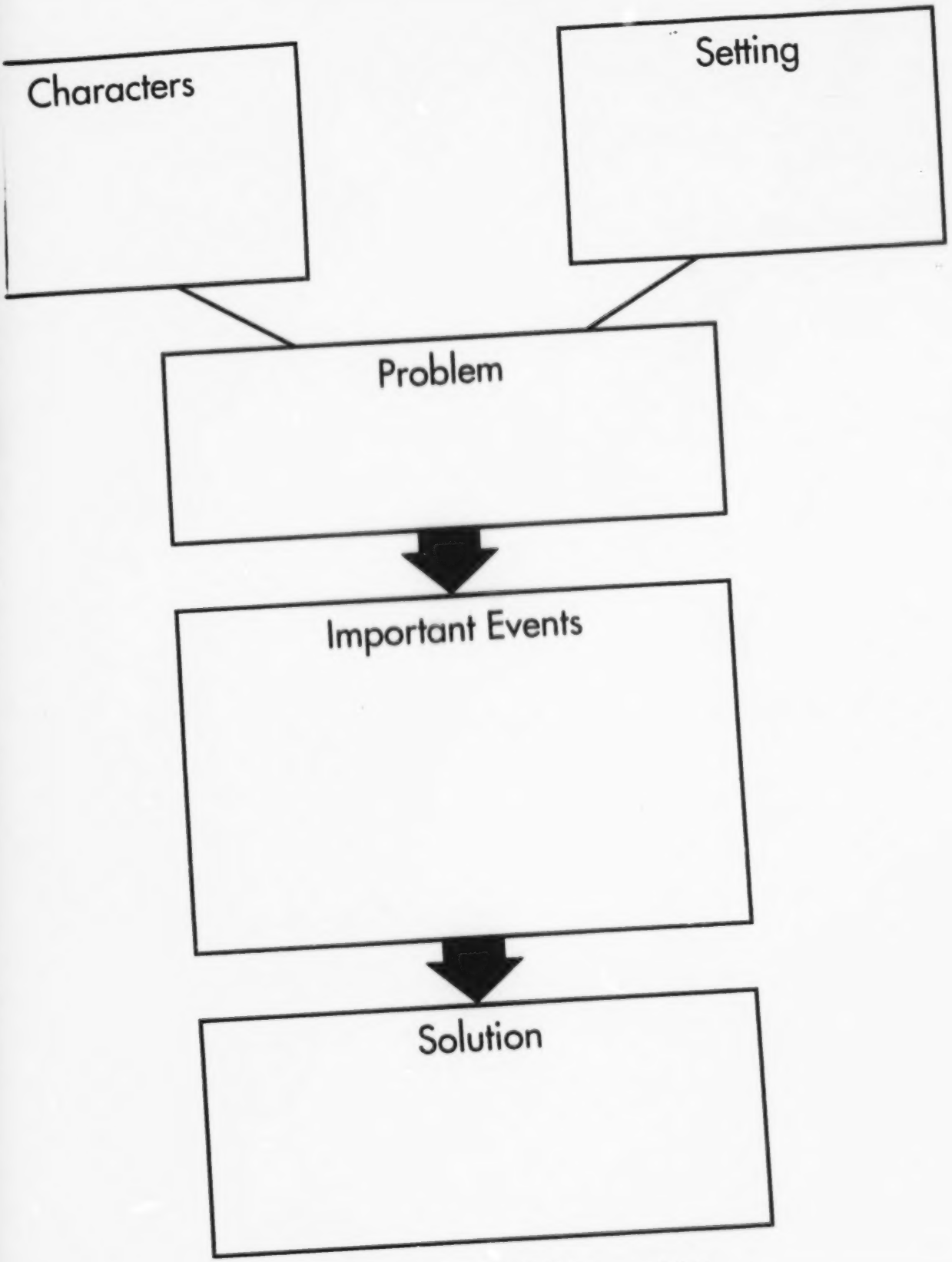


Student's Name: _____

Copyright © Creative Learning Consultants


1
2
3
4
5
6
7
8

Story Map



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Lesson Plan- Wordsplash

Objective: Students will become acquainted with one another and their teacher.

Procedures:
Stimulus: Wordsplash that features the teacher's likes, hobbies,talents,interests,and achievements. The teacher will ask questions about the words.

Activity:Invite students to create personal wordsplashes for themselves on a puzzle piece or sheet of paper.

Follow-up: Have them share with a partner about what they have written. If they wish have them share with the class.

Evaluation: What did they like? What was interesting? What would they do differently/ What would make this activity better?

THIS IS YOUR LIFE

_____ _____

dance

silver buick

Ohio

sewing

books

travel

travel

laugh

Metamora

teach

Washington

learning

apartment

purple

cookies

school

two wheeler

kids

nikes

ice cream

malls

write

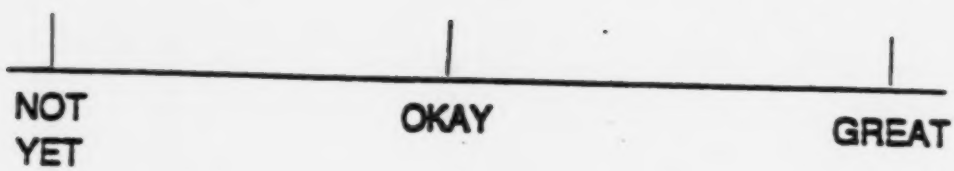
red

nikes

swimming

thinking

GRADING SCALE



Check List for Writing

- ☑ Capital letters
- ☑ Number one sentence
- ☑ #2 sentences (2)
- ☑ #3 sentences(2)
- ☑ Ending sentence
- ☑ Space between each line
- ☐ Transition words

Likert

9	8-7	6-5	4-0
S	N	I	U

Check List for Writing

- ☑ Capital letters
- ☑ Number one sentence
- ☑ #2 sentences (2)
- ☑ #3 sentences(2)
- ☑ Ending sentence
- ☑ Space between each line
- ☐ Transition words

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STUDENT CHECKLIST: Cooperation

I contributed my ideas and information.

Always — Sometimes — Never

I asked others for their ideas and information.

Always — Sometimes — Never

I summarized all our ideas and information.

Always — Sometimes — Never

I asked for help when I needed it.

Always — Sometimes — Never

I helped the other members of my group learn.

Always — Sometimes — Never

I made sure everyone in my group understood how to do the school work we were studying.

Always — Sometimes — Never

I helped keep the group studying.

Always — Sometimes — Never

I included everyone in our work.

Always — Sometimes — Never

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FIGURE 3.

MATHEMATICS SCORING RUBRIC: A GUIDE TO SCORING OPEN-ENDED ITEMS

SCORE LEVEL	MATHEMATICAL KNOWLEDGE Knowledge of mathematical principles and concepts which result in a correct solution to a problem	STRATEGIC KNOWLEDGE Identification of important elements of the problem and the use of models, diagrams and symbols to systematically represent and integrate concepts	COMMUNICATION Written explanation and rationale for the solution process
4	• shows complete understanding of the problem's mathematical concepts & principles • uses appropriate mathematical terminology & notation (e.g. labels answer as appropriate)[1] • executes algorithms completely and correctly	• identifies all the important elements of the problem and shows complete understanding of the relationships among elements • reflects an appropriate and systematic strategy for solving the problem • gives clear evidence of a complete and systematic solution process	• gives a complete written explanation of the solution process employed; explanation addresses what was done, and why it was done • if a diagram is appropriate, there is a complete explanation of all the elements in the diagram
3	• shows nearly complete understanding of the problem's mathematical concepts and principles • uses nearly correct mathematical terminology and notations • executes algorithms completely; computations are generally correct but may contain minor errors	• identifies most of the important elements of the problem and shows general understanding of the relationships among them • reflects an appropriate strategy for solving the problem • solution process is nearly complete	• gives a nearly complete written explanation of the solution process employed; may contain some minor gaps • may include a diagram with most of the elements explained
2	• shows some understanding of the problem's mathematical concepts and principles • may contain major computational errors	• identifies some important elements of the problem but shows only limited understanding of the relationships among them • appears to reflect an appropriate strategy but application of strategy is unclear • gives some evidence of a solution process	• gives some explanation of the solution process employed, but communication is vague or difficult to interpret • may include a diagram with some of the elements explained
1	• shows limited to no understanding of the problem's mathematical concepts and principles • may misuse or fail to use mathematical terms • may contain major computational errors	• fails to identify important elements or places too much emphasis on unimportant elements • may reflect an inappropriate strategy for solving the problem • gives minimal evidence of a solution process; process may be difficult to identify • may attempt to use irrelevant outside information	• provides minimal explanation of solution process; may fail to explain or may omit significant parts of the problem • explanation does not match presented solution process • may include minimal discussion of elements in diagram; explanation of significant elements is unclear
0	• no answer attempted	• no apparent strategy	• no written explanation of the solution process is provided

[1] "As appropriate" or "if appropriate" relate to whether or not the specific element is called for in the stem of the item. Adapted from Lane (1993)

PROBLEM-SOLVING JOURNAL RUBRIC

SCORE 6 EXEMPLARY ACHIEVEMENT

*Demonstrates internalized understanding of major concepts.

_____Solves problem and gets correct answer.

_____Shows computation compete ly and correctly.

_____Labels answer correctly.

_____Gives a complete explanation of what was done and why it was done.

_____Draws and labels strategy used. (diagram, list, etc.)

_____Explains elements of strategy.

_____Describes other possible strategies.

SCORE 5 COMMENDABLE ACHIEVEMENT

*Demonstrates detailed understanding of major concepts

_____Solves problem and gets correct answer.

_____Shows computation completely and correctly.

_____Labels answer correctly.

_____Gives a complete explanation of what was done and why it was done.

_____Draws and labels strategy used. (diagram, list, etc.)

_____Explains elements of strategy.

SCORE 4 ADEQUATE ACHIEVEMENT

*Demonstrates a general understanding of the major concept.

_____Solves problem and gets correct answer.

_____Shows computation but may have minor errors.

_____Labels answer correctly.

_____Gives a nearly complete explanation of what was done and why it was done.

_____Draws and labels strategy used. (diagram, list, etc.)

_____Explains elements of strategy.

SCORE 3 SOME EVIDENCE OF ACHIEVEMENT

*Demonstrates some understanding of the major concept.

_____Solves problem with some understanding.

_____Shows computation but may have major errors.

_____Labels answer correctly.

_____Gives some explanation but is vague or difficult to understand.

_____Draws and labels strategy with some errors. (diagram, list, etc.)

_____Explains strategy unclearly.

SCORE 2 LIMITED EVIDENCE OF ACHIEVEMENT

*Demonstrates a Lack of Skills Necessary to Reach Solution.

_____Solves problem with little understanding.

_____Shows some computation with major errors.

_____Labels answer incorrectly or no label.

_____Gives minimal explanation, may not match solution.

_____Attempts to draw and label strategy with major errors.

_____Little or no attempt to explain strategy.

SCORE 1 INADEQUATE EVIDENCE OF ACHIEVEMENT

*Demonstrates a lack of understanding.

_____Attempts to solve problem, misinterprets.

_____Shows inaccurate computation.

_____Labels answer incorrectly or not at all.

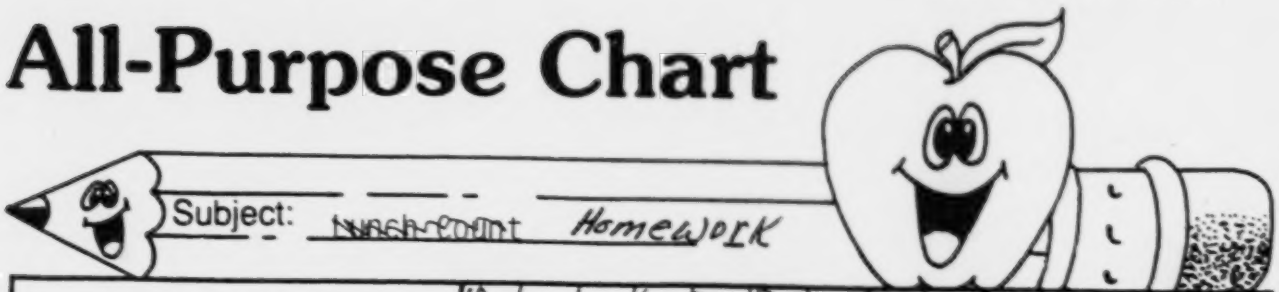
_____Gives inadequate explanation.

_____Little or no attempt to draw and label strategy.

_____Little or no attempt to explain strategy.

SCORE 0 NO RESPONSE

All-Purpose Chart

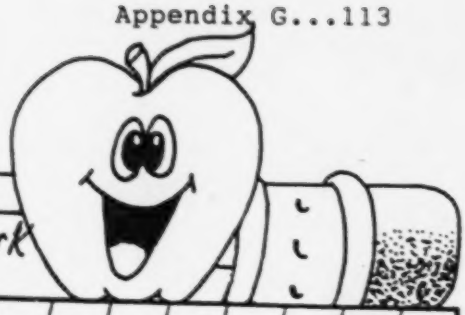


Subject: ~~Lunch Count~~ Homework

Name	Stairway From the Sky	Queen's Jewels	Math Riddles	Jungle Swing	Out Goes X-O-U	Which Witch is Which 8-7	Brain Twisters 10-14	Language Problems 10-21	Hunt For Safe 10-28	How to Go from Here to There 11-4	Build a Robot 11-4	Keys to Thinking 12-2	Ghoul Gourmet 12-2	Speedy Squirrel 11-25-96	Unidentified Presents 12-9-96	12-16 Christmas	Cockeyed
Anthony Bannan	X	X	-2	X	-1		X	-5	X	-8	X	1	1	1	1	-3	
Grant Barrett	X		X	X	-1		-2	-3	-2		X	X	X	-1	-5	-6	
Griffin Carr	X	X	X	-1	-2		-1	-4	X	-18	X	X	-1	X	X	-2	
Scott Cornell	X	X	X	-1	-2		-4	-5	X	-7	X	-3	X	-1	X	-3	
Brittney Crow	-2		X	X	-4		-1	-6	X	-1	-1	-1	-1	-2	X	-3	
Jill Doty	X	X		X	X		-2	-11		-6	X	X	-2	X	X	-1	
Bradley Dragoo	X	X	X	*	-1		-2	X	X	X	X	X	X	-3	-5	-3	
Sarah Gendron	X	X	-3	-1	-4		-2	-6	-3	-17	-5	X	X	-4	-3	-3	
Matthew Kaup	X	X	X	-1	X		-2	-1	X	X	X	X	-1	-1	X	-2	
Kyle Kiesewetter	X	X	-1	X	-6		-3	-11	X	-2	X	X	-1	-1	X	X	
Justin Knobeloch	X	-1	X	T	X		-2	-4	-1	X	X	X	-1	X	X	-2	
Jill Larson	X	X	X	*	X		X	-1	X	X	X	X	-1	X	X	-2	
Matthew List	X	X	-1	X	X		-1	X	X	X	X	X	-1	X	X	-1	
Tavi Lopez	X	X	-2	X	-4		-1	-4	X	X	X	X	X	-8	-		
Justine Mooberry			X	-2	-4		-4	-28	-5	-18	X	-1	O	X	X		
Jimmy Mullins	X	X	X	-1	X		X	-1	X	X	X	-1	X	X	-		
Kaitlyn O'Shea	X	X	-4	*	-2		-1	-2	X	*	X	-1	X	X	-2		
Josh Portscheller	X	X	X	*	-2		-1	-3	X	X	X	-2	X	-4	X		
Harold Presley	X	X	X	-1	X		-3	-1	X	X	X	-1	X	X	X		
McKenzie Reynolds	X	X	-1	-1	X		-1	-2	X	-4	X	X	X	X	-1		
Sarah Schupp	-1	X	X	-1	-3		-1	-3	X	*	X	X	X	X	X		
Shawn Senn	X	X	-1	-1	X		-2	-4	X	-3	X	X	X	X	-1		
Allison Swartzentruber	X	X	X	-2	X		-1	-1	X	-6	X	X	X	X	-1		
Andrew Wall	X	X		X	-1		-3	-23	X	-6	X	X	X	X	-2		
Danielle Wernsman	X	X	-1	-2	-5		-2	X	X	-2	X	X	X	X	X		
~~Mrs. Schrock~~ Cameron							X	Homophones		-5	X	-4	X	-1	X		
	11 Possible						10 Pts.										
hot																	
cold																	
ala carte																	

Problem Solving (2) Problem Solving (7) Logical Thinking (8) Problem Solving (5)

All-Purpose Chart



Subject: ~~Lunch Count~~ Family Homework

| Name | Cameron Arnoldi | Stick Deep Breath (3) | Following Directions | | |

SUBJECT Thinking Skills

PERIOD BEGINNING

PERIOD ENDING

CLASS

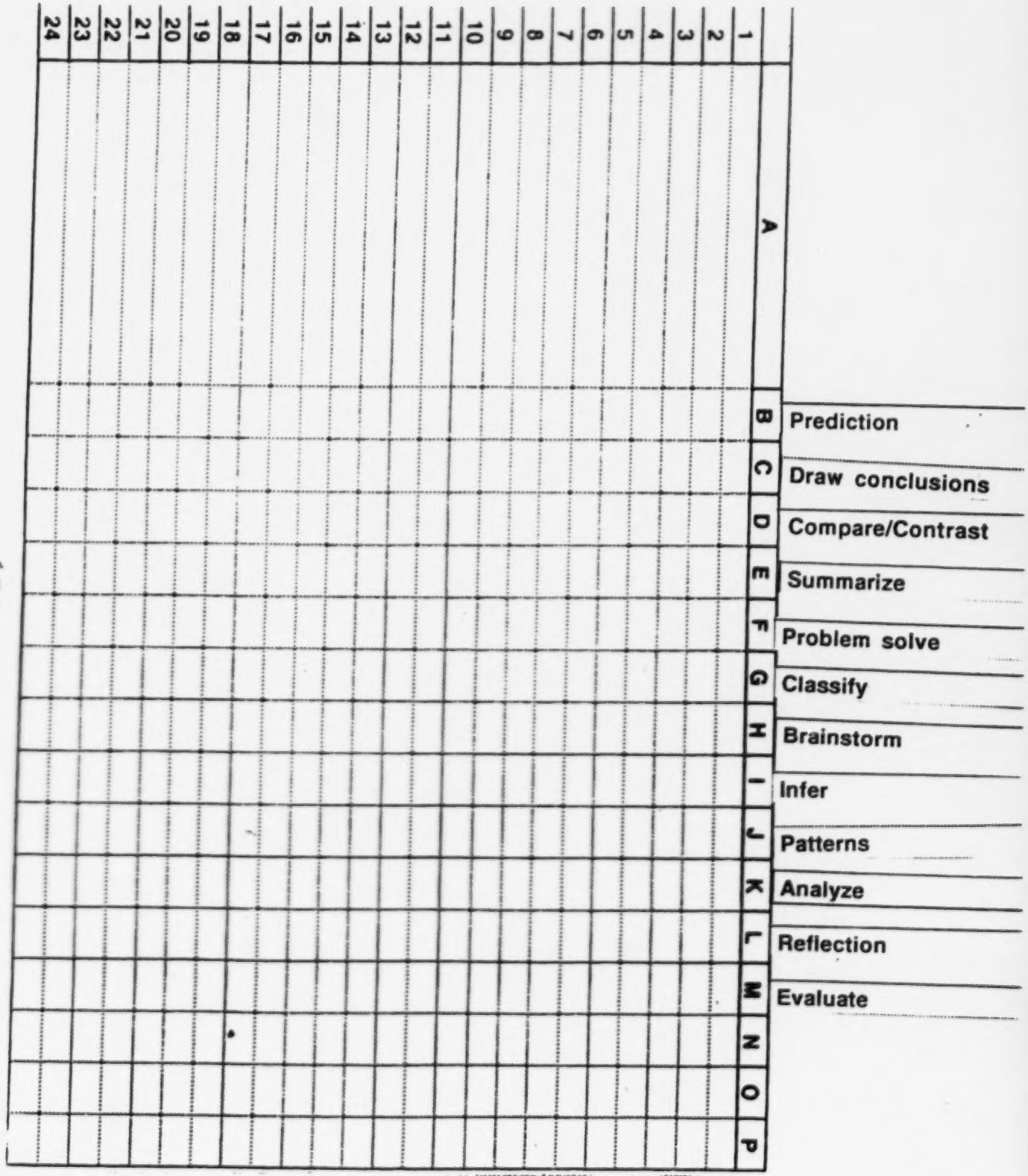
TIME

		1st Week					2nd Week					3rd Week					4th Week					
		M	T	W	T	F	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F	M
1	Anthony Bannan																					
2	Grant Barrett																					
3	Griffin Carr																					
4	Scott Cornell																					
5	Brittney Crow																					
6	Jill Doty																					
7	Brad Dragoo																					
8	Sarah Gendron																					
9	Matthew Kaup																					
10	Kyle Kiesewetter																					
11	Justin Knobeloch																					
12	Jill Larson																					
13	Matthew List																					
14	LaTavish Lopez																					
15	Justine Mooberry																					
16	Jimmy Mullins																					
17	Kaitlyn O'Shea																					
18	Josh Portscheller																					
19	Harold Presley																					
20	McKenzie Reynolds																					
21	Sarah Schupp																					
22	Shawn Senn																					
23	Allison Swartzentruber																					
24	Andy Wall																					
25	Danielle Wernsman																					
26	Cameron Arnoldi																					
27	Nicole Screirer																					
28	Timothy Hayes																					
29																						
30																						
31																						
32																						
33																						
34																						
35																						
36																						
37																						
38																						
39																						
40																						
41																						
42																						
43																						
44																						
45																						

Language Prob. (20) Valentine's Day

Logic Problems (4) (4) Reading Riddles
Following Directions Summary - Group Work (6)
Diggins
Balancing Acts - Logical Thinking
Brain Twisters (4) (1-31)
Problem Solving Brain Buster (43)
I Still Too Many Bikes (2) Thinking
Family Homedock - Build a Bank (96) Writing

Brain Buster - Math (5) Brain Buster Math (1-20) (originals)
Mind Mapping Nouns (45) 11-25
Problem Solving Brain Buster
Pumpkin Puzzler (4) (1-3)


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
A
B Prediction
C Draw conclusions
D Compare/Contrast
E Summarize
F Problem solve
G Classify
H Brainstorm
I Infer
J Patterns
K Analyze
L Reflection
M Evaluate
N
O
P

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
		Prediction 2-13 . 12	Draw conclusions	Compare/Contrast 4 Venn Diagram (9)	Summarize Story Map 2-4	Problem solve 4 Problem P. 161 (2c)	Classify Transportation	Brainstorm	Infer	Patterns Look Alikes hearts (9) 2-4	Analyze Data Cell + Anal	Reflect 2-21 Writer Writer	Evaluate PMI 2-7	Summary Little Book 2-27 (6)	Comparing/Contrasting 2-13 Family Homework Bike	Pattern - Science Ac (8)
1	Cameron Arnoldi	X		X	X	15	-1	20		X	S -1	E	X	X	X	X
2	Grant Barrett	-5				14	X	4		X	E	E	X	X		-1
3	Griffin Carr	-6		X	-3	15	X	5		X	S -1	S	X	-1	-3	
4	Scott Cornell	X		X	-1	14	X	9			S -1	E	X	X	X	-1
5	Jill Doty	X		X	X	15		16		X	E		X	X	X	
6	Brad Dragoo	-3		-1	-1	17	X	16		X	S	E	X	X	X	-1
7	Sarah Gendron	-5		-3		14	X	4		X		S	OK	-1		-1
8	Timmy Hayes	-6			-1	16		16			11	S	OK	-4		-1
9	Matt Kaup	-5		X	-2	15	X	5		X	S	E	X	-1	X	-1
10	Kyle Kiesewetter	-2		-2	-1	15	X	5		X	&	S	X		X	X
11	Justin Knobeloch	-1			-2	15	-1	16		X	E	S	X	X	-1	
12	Jill Larson	X			X	16	X			X	E	E	X	X	X	-2
13	Matt List	-2		X		14	-1	16		X	E	S	X		-1	
14	Tavi Lopez	-3		-2	-1	15	2	5		X	U	E	X	X	-2	-1
15	Justine Mooberry	-3				17	X	20		X	E	S	X	-1	-2	-1
16	Jimmy Mullins	-4			X	16	-2	16			E	S	X	-1	-2	X
17	Kaitlyn O'Shea	X		X	X	14	X	9		X	S	E		-1	X	X
18	Josh Port Scheller	-2		X		14		9		X	E	E	X	-1	X	-2
19	Harold Presley			X	-1	15		10			E	S	-1		X	
20	McKenzie Reynolds	X		X	X	16	-1	16		X	X	E	X	X	X	X
21	Nicole Scheirer	-3			-1	14	-1	20		X	-1/5	F	X	-3		X
22	Sarah Schupp	-1			-1	15				X	X	E		-1		
23	Shawn Senn	-2		-1	-1	17	X	4		X	S	E	X	X	X	X
24	Allison Swartzentruber	X		X	X	14	X	9		X	E	E	X	-2	X	-1
	Andy Wall	-5		X	X	17	X	20		X	E	E	X	X	X	-1
	Danielle Wernsman	-1		X	-1	14	X	4		X	E	E	X	-1	X	X

PROGRESS CHART

Math Journals

students' names	assignments	3	9-4	9-6	1	9-9	9-11	2	9-18	9-19	9-20	9-23	3	
Emma Alvis	☆		PS,#,E	$,Patt,MM					Every	ALL				
Molly Arvin	☆	PS,E	PS,E	PS,PAT	#	E	☆		E,T	E,O,#	PS,E,MM			1T
Josh Blumenshine														2T
Katie Boisseau	#,PS,E	PS	$			☆	☆		☆	☆	☆			
Christopher Bonald														3c
Tim Cole	T,E				☆		✓		every					10c dg
Erica Hardwick		PS,E							P					4c
Brandon Hartl	PS,$	PS,#	PS	☆	$		✓		MM		☆			5c
Heather Hobson	P.S.	E,PS	☆	Pat,MM	PAT	☆	☆			E	☆			6c
Stuart Jones	MM	[redacted]				E	T		☆	☆	☆			7t
Lesli Kennell	P.S.	$	PS		☆	MM	☆		☆	☆				
Kyle LiaBraaten	E	☆	PS	☆	☆	☆	✓		T		☆			8c
Jimmy Mahannah	PS	[redacted]					✓		PS					9c
Matthew McClaken	PS	☆					✓		Patt	$,	☆			
Anthony Michels	☆	☆	☆		☆		☆		☆		☆			
Ryan Mountz	$,T													AB 17
David Meyers	PS,E		PS	PS,#					PS					10T
Adam Noe	PS,MM	PS,E	PS,$	☆	#,ET		✓		PS	☆	E,T			11T
Aaron Phelan	☆	PS,E	#,PS	☆		☆	✓		PS					
Jen Pinke	#,E			E,PS	PS	☆	✓		PS	PS,MM,$,E	#,E,MM			12T
Daniel Romersb.	#E,T	[redacted]		PS,#	E,$	#,MM	✓		every	$,	#,MM			13T
Emily Sandy	☆	☆	PS	☆	☆		✓		☆		INC			14T
Bradley Schmidt		$,PS,#	☆	☆	☆		☆		PS	PS,$	E,#			15T
Erin Zimmerman	P.S.	E,PS	☆			☆	✓		$	MM,PS	E,PS			16T

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" Honorary Grandparents," New Friends for Third Graders

Snyder Village is a neat place to visit and find new friends. Before school started Mrs. Schrock talked with the activity director about having students adopt a grandparent for the year. Third Graders went for their first visit in October and a second visit in November. Before going each time the students worked and developed questions to ask their grandparent. They took along their thinking log books with their questions written on the one page and they put their answers on the page right beside it. After completing the interview they visited and read a story from their reading books with their adopted grandparent.

The second visit in November they again asked some interview questions. We talked extensively in class about "fat" questions and "skinny" questions as they were developing their questions. Fat questions are questions which generate sentence responses or stories or thoughtful answers while skinny questions may only generate one word answers. Before going they asked each other as well as Mrs. Schrock some of their questions. By verbalizing they were able to often identify the ones that were fat and skinny. Their questions became better as they verbalized them. Mrs. Schrock suggested they ask questions about when their grandparent was young and went to school. By asking fat questions they were able to hear many stories. After this visit they took the information and wrote biographies of their "honorary grandparent."

These visits have been a rewarding experience for both third graders and adoptive grandparents. Students have reflected on the experince in their thinking logs and have felt quite positive about their "honorary grandparent." They have written and shared many interesting parts of their visits. The grandparents from Snyder Village involved in the program have also been excited and enthusiastic about the visits.

Future events and activites are also being planned. On Tuesday November 26, the grandparents have been invited to the school for a play given by the third graders. We have asked several of them to share some stories with us as well. Students wrote and sent each grandparent an invitation. We will go again in December and will interview them on their Christmases in their childhood. Other monthly meetings are being planned as well including some crafts and games.

FAT?

1. What are some of your hobbis? crochet. read.
2. Did your Grandma do things with you? What? Yes, they quilted
3. Do you have children? Who? How many? 2 sons
4. Do you like flowers? why? Yes, beutiful

SKINNY?

1. What is your name? Betty Lane
2. How manny years have you lived here? 5 years
3. Did you have a quilt? yes
4.

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PMI GRAPHIC ORGANIZER

Plus
Minus
Interesting

IRI SkyLight

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Good

(trainer) H We had fun playing bingo. I hope we go back soon.

H We didn't have alot of time to play bingo.

P/D orth yours quilting when I came in.

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McKenzie Reynolds Good

Pt Elizabeth was there, and That we played bingo. Elizabeth had fun I enjoyed talking to Elizabeth

M- Is that I dont get to see her for a month and that the time went by. also by walking back and forth in cold weather

- Is that valintines is sort of the same as long ago that her favrite part of valintines is love and deserts. and that Elizabeth has never missed one yet.

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Interview

1. What's your name?
2. What are your hobbes? what is
3. have you met my dad, mybe
and my mom?
~~4. Have you ever married?~~
4. How old are you and when is
your? birthday
5. How long have you lived here
6. Tell me some thing thats interesting
about you?

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1. Eulah Bachman
2. 6 years
3. Yes likes cards
4. Knitting, plays games
5. 83 age
6. a lot diffrent when little
7. likes the she dose like
8. like to watch oldrin interesting

I went a ladys named Eulah Bachman she is 83 years old. I am her relativ. She has lived at Snyder 6 illage six years. She has a husband Well. They are nice. I like them. She likes cards, knitting, playarying gams, Johnny Appleseed.

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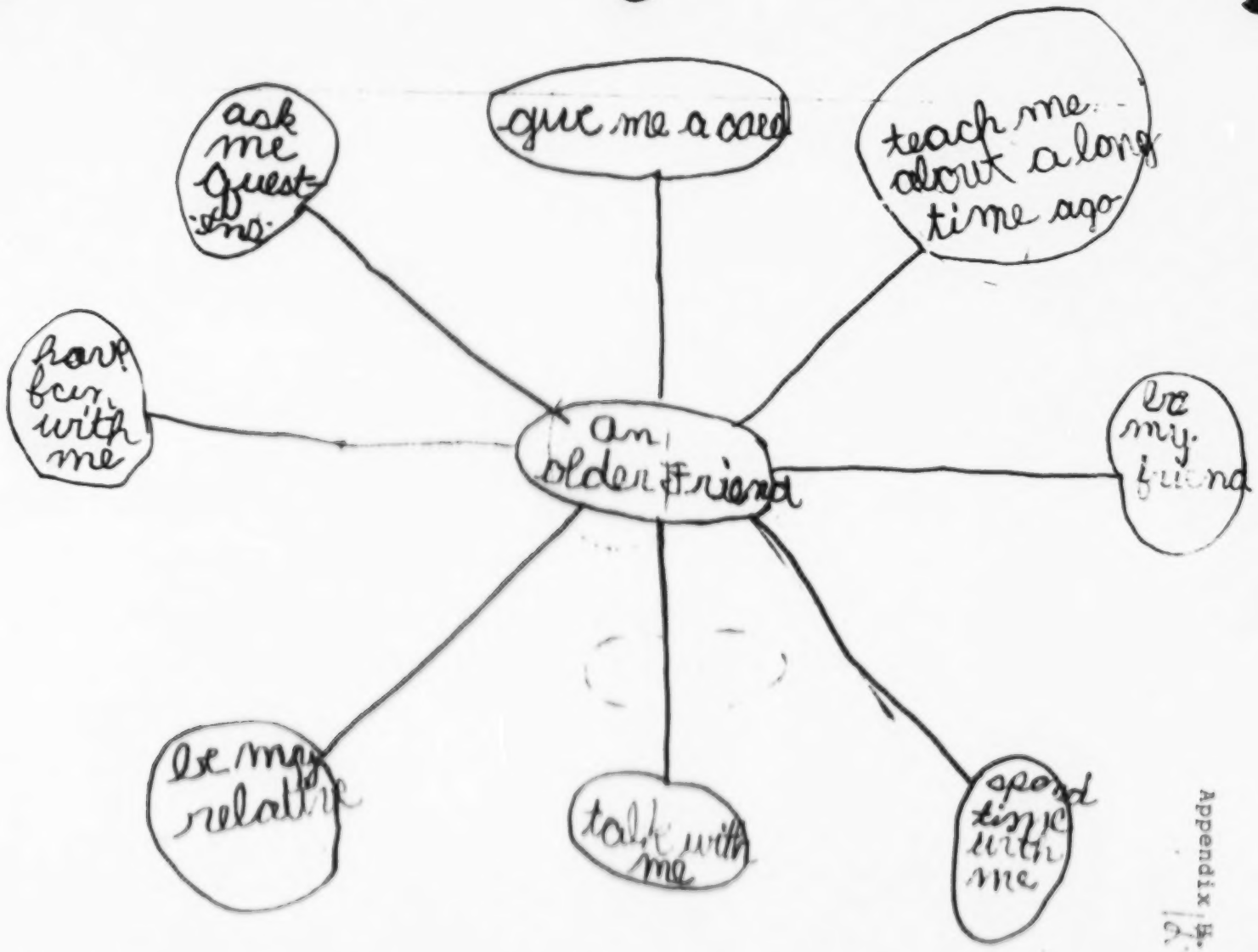

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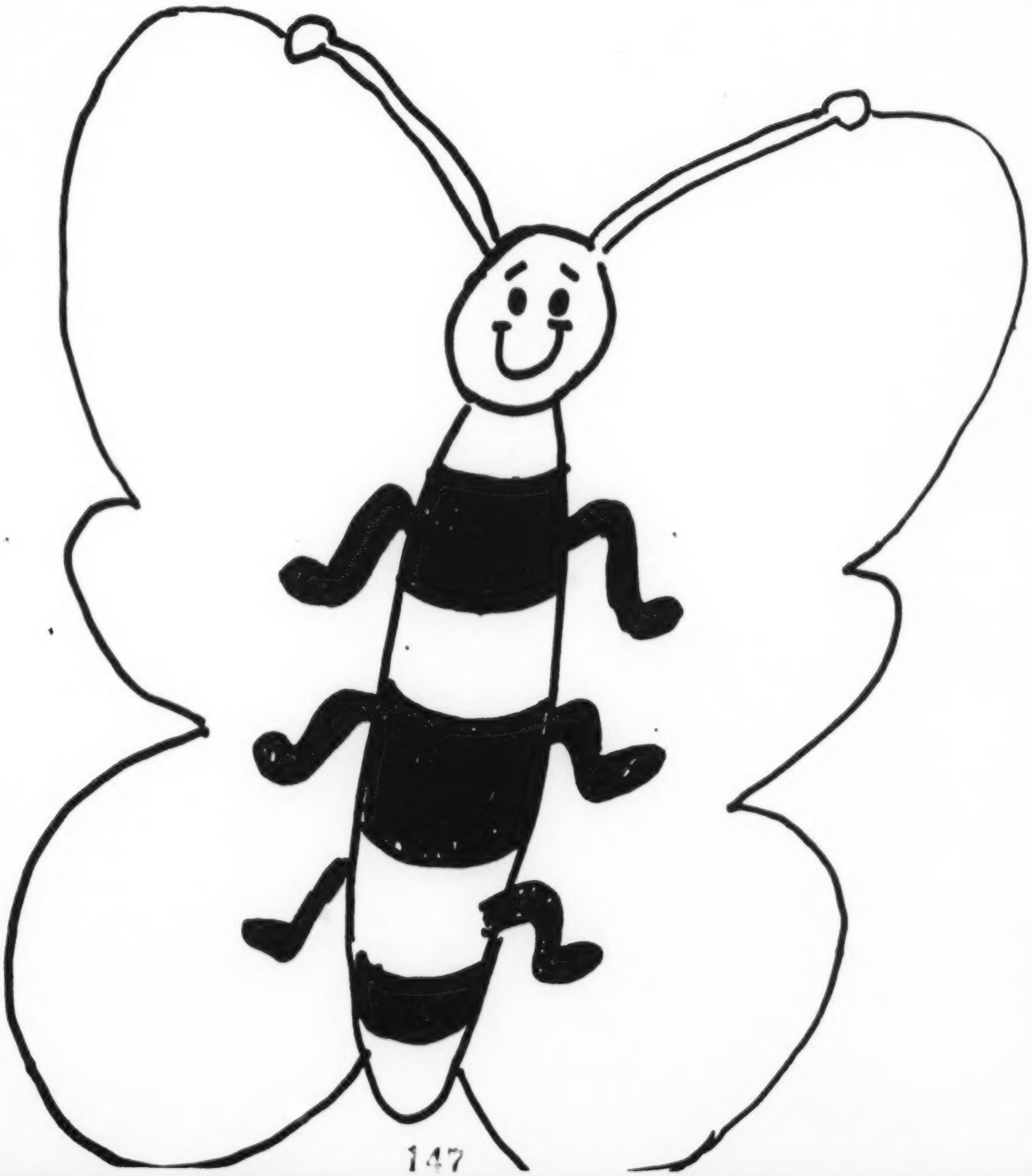
Appendix H...125.

March, 1991

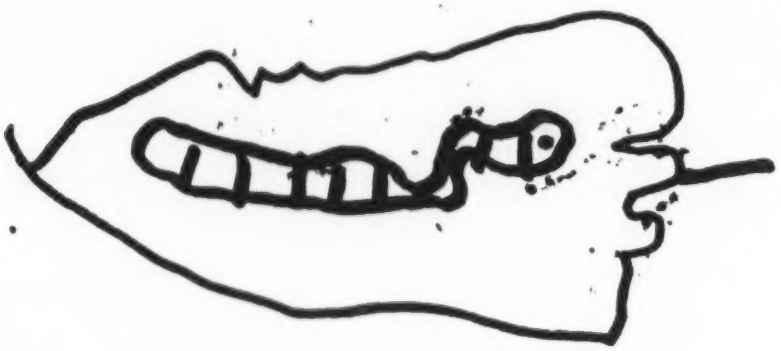
It's fun to write to
class once a month.

First we rode the bus to
Singer Village. We talk
read, and answered ques-
It was fun. A man from
paper took our pictures. We put
hats in a quilt. I
read Winter Days and
Winter Nights and The
Wednesday Surprise.
I gave Mrs. Dean a card.
She gave me candy.

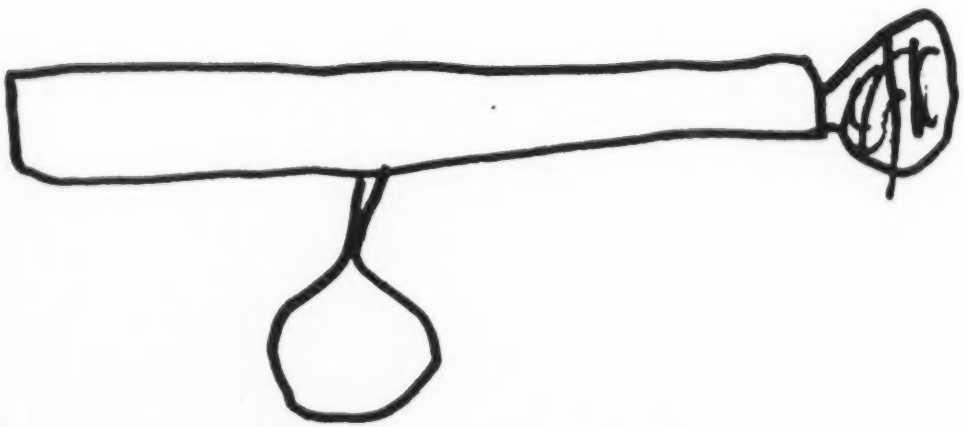
BEST COPY AVAILABLE



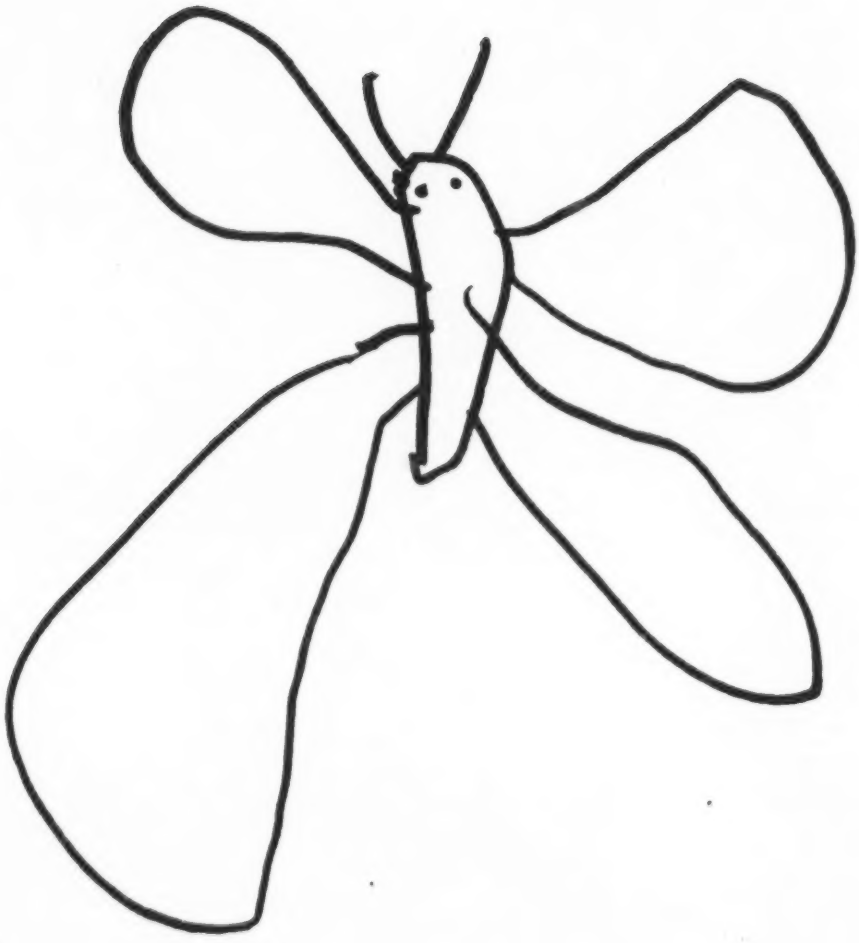
First there is an egg



Next it turns into a ~~caterpilar~~



Next the CATERpilar makes a chyrsa



L 15.
Last the chrysalis turns into a butterfly.